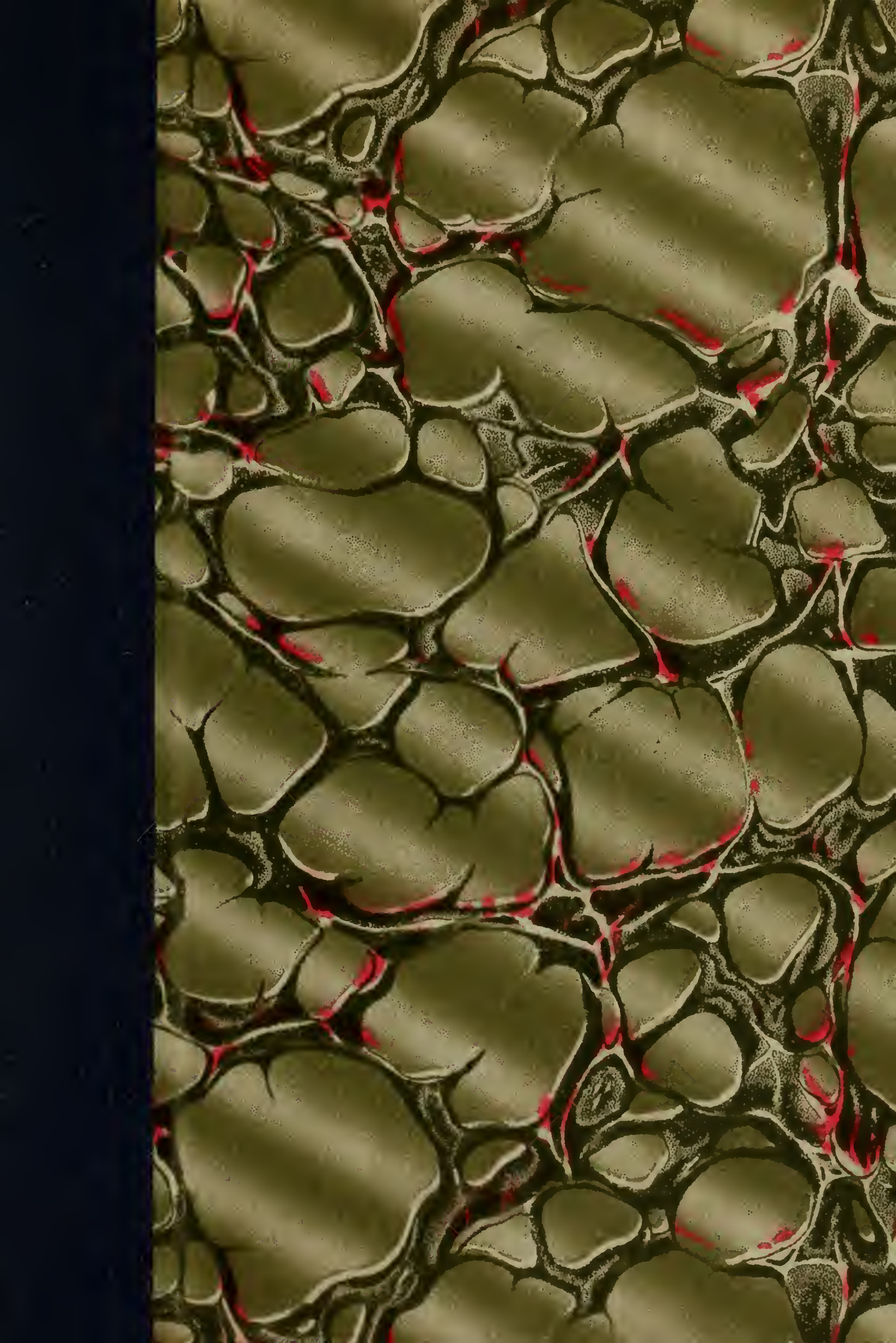

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PROSPECTUS.

With the new year we undertake the arduous task of adding another to the already extensive list of dental periodicals now before the profession. We shall make no apology for its appearance, nor ask any consideration for the enterprise other than that which its merits can command. We think it proper to say, however, that this publication comes before the profession with a scheme different from that of any contemporaneous dental journal, and should therefore be viewed in a somewhat new light, as regards its bearings on the world of professional thought and ideas.

The founder of this journal esteems himself fortunate in being able to present to subscribers the full and unabridged proceedings of the New York Odontological Society, as they regularly occur; this being the *only* method of publication which the Society now uses. These proceedings will take the place, to a large extent, of the numerous, but varyingly-meritorious, original articles which form the bulk of the literary matter in all other dental periodicals. Thus the publisher is assured of a large amount of material of much more than ordinary scientific and professional value, while readers obtain the carefully-considered thoughts, theories and practical results of some of the very best minds in modern dentistry. This magazine will also be the official organ of the Odontological Society in its public communications with its members and with the profession.

Other original matter will also find a place in the journal, but under such censorship as will exclude all but really meritorious articles on scientific or professional subjects of importance. New publications will be noted and carefully reviewed as they appear. A surgical department will contain selections of scientific interest, carefully culled from the medical and dental publications. Any matters of sufficient professional importance outside the literary work of dentistry will receive attention. Trade, in all its phases, will be rigorously excluded from the literary department, in which no puffs or advertisements of any business, any material or any individual will be allowed to appear. At the same time, the advertising department will afford a means of communication with consumers unequaled, it is believed, in dental journalism.

To conclude, it is designed to give to the new periodical as high a character for scientific professional literature as can be found in the journals of this or any other profession. To attain this end, much must necessarily be excluded which, possessing merely local or temporary value, makes no mark on the permanent record of professional excellence. The publisher is aware of the great difficulty in attaining to and upholding so high a standard; but he believes the time has come when the profession will welcome and encourage such a journal; and, relying upon this belief, he pledges himself to do his part toward perpetuating the undertaking strictly in the course marked out above, in the full hope that his efforts will be ably seconded, and rendered successful, by the appreciation and aid of that professional public of which he is ever the obedient servant.

R. S. WILLIAMS.

Dental and Oral Science Magazine

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New York Odontological Society.

Special Meeting, November 20th and 21st, 1877.

The Society was called to order at 8 o'clock P. M., November 20th, Dr. A. L. Northrop, President, in the chair. The essayist of the evening, Dr. J. Foster Flagg, of Philadelphia, spoke as follows:

PLASTIC FILLING, AND THE BASAL PRINCIPLES OF THE NEW DEPARTURE.

BY J. FOSTER FLAGG, D.D.S., OF PHILADELPHIA.

Mr. President, and Gentlemen of the Odontological Society of New York: I wish to thank you, from the very bottom of my heart, for the invitation you have extended to me to speak to you this evening. I wish you to understand that I distinctly appreciate the honor which you have conferred upon me by giving me more than ten times the usual limit given to one who speaks before you. Furthermore, gentlemen, I know that you are well aware that I have much to present to you which is out of the ordinary course of communications to dental societies. But, gentlemen, you don't know half what a heretic I am!

That which I bring you to-night is no growth of a day. It is no work of a year. I therefore recognize that what seems to me to sound as it ought to sound, will sound to you just as it ought not to sound. I shall present to you the time-honored and ordinarily "accepted creed" of dentistry, and I shall advocate before you the diametrically antagonistic "creed of the New Departure."

Do you suppose it is a new thing for me to be antagonizing accepted dentistry? No, gentlemen. For more than twenty years I have not known what it is to be upon the "right side."

Twenty-two years ago, my very good and highly esteemed friend, Prof. Robert Arthur, enunciated his belief in leaving decay in the cavities of teeth and filling over it, and it was stigmatized as nasty, dirty, slouchy work, and our "great man," Prof. J. D. White, said that "when he could not spend time to properly clean out the cavities he would retire from practice." Here is a document, written by my honored father's own hand, giving an account of the action of a college faculty on the question: "When the Faculty of the Old College met for the purpose of arranging the last 'announcement' of that school, exception was taken by Prof. White to what he considered as 'false doctrine' on the part of Prof. Arthur, in regard to two prominent features in our art, both of which may be considered of vital importance to our success as instructors, and to the successful practice of many of our graduates. The first of these was, that Prof. Arthur advocated the leaving of caries in the cavity of a tooth and plugging thereon. And the second, deemed equally objectionable, that of using 'sponge gold' as a material for filling teeth, and as a substitute for gold foil. *Now, although every other member of the faculty fully coincided with Prof. White in his opposition to this practice of Prof. Arthur*," etc., etc.

How many of the professors of to-day oppose the "leaving of decay and the plugging thereon" when the pulp would be exposed by its removal? It is now the accepted practice; and yet, only twenty little years ago, it was so heretical and such "false doctrine" that the entire faculty "coincided with Prof. White," and Dr. Louis Jack and Dr. J. Foster Flagg were the only two men of the forty-five hundred dentists of the United States that immediately accepted Prof. Arthur's practice, and from that day to this have systematically left decay in every cavity where its removal would expose a living pulp. Thus you see, it is no new thing for me to question the creed of the profession. I became used to it when I was young, and it has grown with my growth.

Years have rolled on, and, as you know, without much attendance on my part at dental meetings; but do you suppose I have been doing nothing? Far from it. Day by day I have filled tooth after tooth and have marked what I have done. Year by year I have tabulated results until they now amount to thousands upon thousands. Letters by the score have passed between Syracuse, St. Louis and Philadelphia. At length I wrote to my friends, Drs. Palmer and Chase, that I felt we were as ready now as ever we should be.

Gentlemen, we believe that we have, for our "New Departure," grand, basal, foundation principles, which have so grown with us that they already seem as old and as solid as the hills.

More than twenty years ago, Prof. Elisha Townsend gave to his contemporaries the assertion that he "saw daily the undeniable evidence of the fact that teeth could be saved with amalgam, which *he* could not save with gold." His memory is revered by us all. As a worker in gold he was unsurpassed—as a proof of his estimation of plastic filling he gave to his profession "Townsend's Amalgam," that material with which we began our labors, that material which had so much of good in it that we were more and more impelled, as the years passed by, to recognize its value.

I feel that I owe much to Prof. Townsend, for he made the way of experiment easy for me. Within a very short time after his death, nearly two hundred of his families became my patients. This not only placed me (then a beginner *in Philadelphia*) at once in full practice, but enabled me to cultivate a ground for plastic filling, which had been well broken by one in whom they had unbounded confidence. Now, gentlemen, the statistics which I propose to offer to-night have been based upon this experience.

Article I. Accepted creed: Gold is the best thing to save teeth.

Article I. New Departure: In proportion as teeth need saving, gold is the worst material to use.

Gentlemen, I am, for the moment, literally but a mouth-piece; Dr. Chase has spoken to you. This article is his. He was the first who had the hardihood to say that "in proportion as teeth *need* saving, gold is the *worst* material to use." This he has said, and Dr. S. B. Palmer and I fully endorse that which he has spoken.

Mark my words! This is a real *belief* which I am speaking to you. Men are coming to our belief every day—the thinking men, the observing men of dentistry. They write me that they introduce their beautiful jewels of gold, with the view of their premature wreck staring them in the face! That with their very best and long continued effort, they are unable to save teeth as they would *with gold.*

And is this nothing? Can a man continue to work and put "piece after piece" in proper place when he feels that the work is killing the patient, and himself, too, and that, when a few short years shall have passed away his work will be good for nothing?

This is what sapped me fifteen years ago. I had been filling teeth *then* for fifteen years. I can show you plenty of plugs of gold—not twenty or thirty, but hundreds—that I introduced more than twenty-five years since, and which are just as good to-day as on the day when they were done. But these were in strong teeth, in places easy and accessible, in teeth that might have gone but little had they been left unfilled; while of the others, of the teeth that *needed* saving, I can but tell you just what all have seen. One by one these teeth came back to me. Day by day I saw my best efforts going to destruction. I *heard* that my work must be defective; but I *felt* that there *might be something lacking in the material.*

And then there were the first of my statistics. It is more than twenty years since this work was begun. Twenty-two years ago I made five hundred fillings. Two hundred and fifty were of gold—just as the cavities came in practice,—the next two hundred and fifty were of tin, gutta-percha and amalgam, the amalgam taking the brunt of the battle and used in places that were too far gone for any other thing. I then waited for five years, watching the progress of events, and, meanwhile, returning to orthodox practice. At the end of this time I was not satisfied, and I waited another year. It was to be a *life-work* with me. I could not do it over again, nor can I. I have done!

At the end of that time the "undeniable evidence" presented itself to my mind. I felt the truth of what Dr. Townsend had said, and came solidly to the belief that *I* could *save teeth* with amalgam which I *could not* save with *gold;* for already in the soft teeth, in the inaccessible places, in the cavities under the gum and with frail walls, the gold fillings were becoming defective, while the plastic fillings far, far better held their own.

To-day, gentlemen, the efforts in gold which formed that trial band have almost passed away; and still quite a number of the plastic fillings, *some even of the most hopeless cases*, are pointed to with pride and satisfaction by their owners.

Seventeen years ago I began the systematic introduction of six per cent. of plastic fillings, choosing, of course, those places best adapted for them—that is, *the worst.* The next year I introduced twelve per cent., the next eighteen per cent., and year by year results were such as warranted this progression. You can readily see where this ends. This is my seventeenth year, and I should have put in 102 plastic fillings in every 100. I found myself not equal to the emergency.

I stand before you with a practice which I have been sixteen years in arranging. I have taken the refuse teeth from all directions; announcing, from year to year, to my patients, that I desired the teeth that were ordinarily extracted, and that I was fast abandoning artificial work, because I felt that I could do my patients better service by repairing wrecks and building crowns on roots. The result is, that I have many mouths in which the teeth have proved themselves wretched beyond wretchedness, yet these are all comfortable. I have teeth by the hundreds such as melt (for they *have* melted) from gold like snow before the sun, at the hands of some of our very best operators.

For all this heap of seeming impossibility I use nothing but plastic fillings. Once in a while I use *tin*, because I am engaged on a series of experiments to discover the action of this metal on dentine. Our filling materials are gutta-percha, amalgam and oxychloride of zinc (so-called). With these I do everything. All this in the mouths of the *very best* class of patients.

"*In proportion* as teeth *need* saving, gold is the *worst* material to use."

This point alone takes in the whole of Palmer's electro-chemical theory of the action of filling materials: but I must tell you what the work of winnowing out the chaff, as far as we could do it, has eliminated.

The work has been borne by Prof. Henry Morton, of Hoboken, and Prof. Snyder, of Philadelphia, scientists; Messrs. Eckfeldt and Du Bois, Assayers of the Philadelphia Mint, metallurgists, and Drs. Palmer, Chase and Flagg, dentists.

We have carefully, and, we believe, scientifically, investigated every line of experiment which has professed to show *the current* which, we believe, is eliminated by contact of metal with tooth-bone. This we have done with the best instruments and apparatus which our country can produce,—and we find that such current *has never been shown*, much less measured. Even that curiously ingenious line of experimentation upon this subject, which was presented at the "Centennial" meeting of the American Dental Association, and which gave to our profession that scale of relativity known as the "Harvard Tension Series," in which gutta-percha was placed at "0" and gold at "200°," and which gave those who had faith in gold such "a black eye" (as it was expressed), we pronounce utterly worthless and without any scientific basis. And yet I will read you Prof. Morton's opinion of that electro-chemical theory upon which we rest our belief, as expressed in this Article I; for if gold *is* the worst material to use, there must be some scientific reason for it.

After speaking of the great difficulty of *current elimination*, Prof. Morton says: "On the other hand, we have the best reason for assuming, on analogy and authority, that all chemical action invokes electrical disturbance. Now acid fluids do act chemically on bone, and the presence of a good conductor, which is itself unattacked, in contact, must, on general electrical principles, assist the electro-chemical action. Supported by your facts of observation, and the reasonableness and consistency of the electric theory, you may well rest your case there. But it is, of course, very important not to give your opponents a chance to attack by resting, for a proof of your theory, on experiments which are themselves unsound and capable of confutation."

Now you see, gentlemen, that notwithstanding the fact that we are unable, as yet, to *demonstrate* the existence of the current, yet, nevertheless, the "reasonableness" and "consistency" of our theory is such, that we may say that gold, being a good conductor and being itself unattacked, when placed in contact with tooth bone must, on general principles, cause excessive electro-chemical action, which action must eventuate in disintegration of tooth tissue; and, therefore, gold is the *worst* material to use when a tooth is of such structure and in such condition as that it needs something which will help to preserve it.

The stereotyped answer to this is couched in these few words: "If gold is so put in as that no fluid can come between it and the tooth bone, there will be no chemical action—because where there is no fluid there cannot be any chemical action." Then, gentlemen, *why don't you put it in so?* If you cannot, then use something else, if for no other reason.

Article II. Accepted Creed: Some have faith in contour, others have faith in separation.

Article II. New Departure: We do not believe that either has much to do with the final result.

For years the discussion between contour and separation has gone on. With Arthur, Bonwill and Chupein for the A, B, C of the "separationists," and Atkinson and Webb as representatives of the whole alphabetic list of "contourists," no definite decision has yet been reached. Now it seems to us that if either was, in truth, decidedly the right way, it would have been found out by this time.

In regard to this contest *we* have been lookers-on, and our statistics do not yet show us which is best. Contour fillings fail, and fillings in separations fail; and when the contours fail it is said, "It ought to have been separated;" and when the fillings in the separations fail, it is said, "The separation is not made rightly." Meanwhile the teeth decay.

For me, in a strong, solid tooth, I would, for durability, just as soon make a contour filling as I would a separation; but on general principles and for comfort I prefer to give my patients the benefit of what is called "contour." My experience is that it is better than the separation—certainly on the score of comfort, and probably on the score of durability.

Article III. Accepted Creed: Failure in operations is mainly due to defective manipulation.

Article III. New Departure: Failure in operations is mainly due to incompatibility of filling material with tooth bone.

Gentlemen, all the elegant fillers—high style, $75, $150, $500 plug men—tell you that failures are due to defective manipulation. Now, gentlemen, if this is so, why don't you manipulate better? Simply because you cannot. And is it nothing against gold that men cannot manipulate it? Is it nothing that this has been proved by an experience of more than half a century? The record of to-day is not better than the record of fifty years ago. You talk about the "finer work," the "improvement in foil," the "improvement in instrumentation," the "blessed rubber dam;" but with all these adjuncts, and while you have put all these gifts to tests which have proved their greatest capability, your results are: larger fillings, more difficult fillings, more tedious fillings, more painful fillings, more expensive fillings, less compensating fillings (both to yourselves and patients), and *more decided failures.* I state this squarely. For every *one* of these large, difficult, tedious, painful and expensive fillings that have given a dozen years of service, I think you will acknowledge that I am within bounds when I say *a dozen* have proved failures.

My statistics show that the average of gold failures, for the last year, is greater than for any previous year. 100 gold failures were classified upon my tables last year, for the whole twelve months; and this year, up to this month, I have already 86, making a total, for 1877, of 103—many of them far worse failures. This is the truth. This shows what attempts are being made and what failures are the results.

It was only on last Friday morning that I renewed (by guarding) a gold filling, which had been introduced *less than three years* before in a cavity upon the *mesial face of the right upper second bicuspid, with the first bicuspid out.* I want you to think of this, and note the exceeding difficulty (?) of the original operation. The patient, Mr. J. W., one of our largest car wheel manufacturers, told me he paid $20 for the filling; and I showed him that I could pass a broad, thin instrument deep into the crevice between the filling and the tooth at almost any point. I told him that *I could not say* of such beautiful work what I believed the gentleman who did it would say of it, viz.: that it must have been *defective in manipulation;* but that I knew just how soft his teeth were (he had formerly been my patient, had left to see if he could obtain better results than I had been able to make for him, *and had returned*), and that I believed the failure was due to *incompatibility of gold with tooth bone.* He said he thought $7 a year was a little too much to pay for one tooth, and then I, naturally (for I am only human), expatiated to him as I am doing to-night to you. I said, "Suppose, Mr. W., that my filling lasts for only three years. It will take me an hour to introduce and finish it, and I shall charge $5. Your former operator charged you $20, because it took him four hours. His work has proved dear, but mine cannot be called cheap, because it returns me the same as his does to him. It may be cheap to you." To which he replied: "Doctor, your argument is just that which the cast iron wheel men use against the steel wheel men, and we consider it solid."

We believe that "failure in operations is mainly due to incompatibility of filling material with tooth bone." This again opens all the question upon which rests our vitality. When I tell you that, *experimentally,* the contact of gold and bone, amalgam and bone, tin and bone, and gutta-percha and bone, results, again and again, in greatest loss of substance in that bone which is in apposition with the *gold,* I say, "He that hath eyes to see, let him see; and he that hath ears to hear, let him hear." And when I see just the same thing occurring in the mouth every day that I practice, and then read that "experiments out of the mouth must be taken for nothing," I cannot but feel that such writers are "straining at gnats," while their patients are "swallowing camels."

Article IV. Accepted Creed: A tooth that is worth filling at all, is worth filling with gold.

Article IV. New Departure: A tooth that can be so treated as to be satisfactorily filled with anything, is worth filling.

The fourth article of the accepted creed and its twin brother, "a tooth that can be filled at all, can be filled with gold," seem to me such perfect puerility that I have no patience with them. This latter enunciation is from our good friend Taft's last work on Dentistry—"up to the present status of the profession," the preface says.

The scathing criticism of this production in the *Cosmos* induced me to examine more closely than I might otherwise have done this effort of Dr. Taft's. Among things like "vacuums" between pulp-caps and pulps, I found this statement, that "a tooth that is worth filling at all, is worth filling with gold." It is also enunciated that "a tooth that can be filled at all, can be filled with gold." But it is not the best, the most acceptable, the most expeditious, or the most comfortable way to do. It is not the most *serviceable* way to do. I assert that experience proves this; but beyond that, I most emphatically deny both assertions. I deny that "a tooth which cannot be serviceably filled with gold, is not worth filling." I deny that "any tooth which can be filled at all, can be filled with gold." No one, not even the most expert, can fill with gold every tooth that can be filled. How much less, then, can the average respectable practitioner of dentistry do this thing? You may get gold into it, after a fashion—but you cannot fill it, according to your own ideal of what a filling should be.

On the other hand, with a plastic filling material it can be filled, and filled nicely, and so as to be comfortable and serviceable for many years. Experience has shown this. The profession, and the coming text-books, when they are truly "up to the status of the profession," will admit it. Therefore we say that "a tooth that can be so treated as to be *satisfactorily* filled with *anything*, is worth filling."

Article V. Accepted Creed: Unskilled and unscrupulous dentists fill with tin covered with gold, thereby causing galvanic action, pulpitis, death of the pulp, abscess, and loss of the tooth.

Article V. New Departure: SKILLFUL *and* SCRUPULOUS *dentists fill with tin covered with gold, thereby* PREVENTING *decay and pulpitis, and thereby saving the tooth.*

Experience had proved that tin would save teeth which gold did not. The accepted belief was, *and is*, that it did so because of its softness and ease of manipulation (for which qualities, by the way, we have never heard it decried). *Our* belief now is that it saves teeth because of its *low conductivity*, and because *it is itself attacked.* Experience had also proved that the tin wore out; and so, the happy combination which would save the tooth and yet not wear out having been devised, it was decried and defamed as "*unskillful* and *unscrupulous.*"

Fifteen years ago this was the accepted practice of my office. It is because of this principle that the operation of "guarding" with a crescentic guard of tin, amalgam or gutta-percha at the "vulnerable spot" has retained failing gold plugs by the hundred for continued usefulness. I, myself, had, up to April, 1877, 1,053 gold plugs, of my own and many other operators', doing service *only* because they had been "guarded" in this way. Gold doing well because it was *taken care of* by *tin*, *gutta-percha* or *amalgam*—a pretty picture!

Article VI. Accepted Creed: A filling, to be good, must not leak.

Article VI. New Departure: A filling may be the best that is known for the tooth, and yet leak badly.

How do we maintain this point? We hold that this is true because of the fact that gutta-percha makes a leaky filling. See this filling in this tube; every care was taken that it should not leak. It was packed even better than it could have been in a tooth, and yet, as you see, it leaks badly. But you will say that a glass tube is not analogous to a tooth. I am prepared for that. Here are small cups of ivory. This material is almost identical with that of tooth bone. These were filled, as you see, the one with red gutta-percha and the other with Johnstons' Premium Stopping; and yet both leak.

Why do we maintain it? We do so from the fact that *we wish to make it a basal principle, that mere leakage, itself, is not the thing* which makes a filling capable or incapable of *saving a tooth*. It depends upon what material leaks, and what it leaks in contact with. If a leak of vitiated saliva occurs between tooth bone and a material which is a *good conductor and is itself unattacked*, then that leaky filling is very bad. But if even vitiated saliva leaks between tooth bone and a material which is, practically, a non-conductor, and which has a surface that is *neither bright nor oxidizable*, then leakage is *proved* by *experience* to be *not* practically detrimental. This we hold to be the reason why gold fillings "eat themselves out" of soft teeth in from two to five years; and why gutta-percha remains untouched (except by attrition), and preserves such teeth for many, many years.

Article VII. Accepted Creed: Gutta-percha, properly used, is good enough for temporary fillings.

Article VII. New Departure: Gutta-percha, properly used, is the most permanent filling material we possess.

When my friend, Dr. Hawes, was in my office for a part of two days, some months ago, I operated before him. Among other patients was a young lady from Orange, New Jersey. I showed him a line of several gutta-percha fillings, in front teeth, which had been introduced seven years before. I showed him a gutta-percha filling in the buccal face of a left lower molar, which he thought was "somewhat cupped" and would "hardly pass for a permanent filling." The patient informed him that it had been doing service for *twenty* or *twenty-one* years, and I added that if it lasted as much longer, I should mark it down as permanent!

Twenty-six years ago Dr. G., of Philadelphia, came to my father, desiring his services. My father introduced eleven gold fillings—good, old-fashioned, solid, "straight from the shoulder" fillings. Besides these cavities, there were four enormous places in the four *wisdom-teeth* (poor teeth, according to accepted views), and these were filled, "experimentally," three with amalgam and one (the buccal face of the right lower wisdom) with gutta-percha, with the idea that they might "last for a year or two." The last one of the eleven gold fillings was renewed a few months since, and the three amalgam fillings, *and the gutta-percha filling*, are still preserving their forlorn and worthless wisdom-teeth, as they have done for *more than a quarter of a century.*

These are not isolated cases. They are, far more, *typical* cases. I have, in the mouths of my patients, hundreds upon hundreds of gutta-percha fillings, which have been doing service for from five to fifteen years, and bid fair to continue so doing for years to come.

Gentlemen, I feel, when I introduce a gutta-percha filling into a large cavity on the buccal, mesial or distal face of a tooth—close to the gum, with frail walls, and almost into the pulp—that I have (if it be possible) saved that pulp. I feel that I have placed there a material which, even if it be gradually softened and worn out, will save the tooth until the last thin stratum, only, still remains. I feel that if it wears, an easy, inexpensive reparation can be effected by the addition of a little more of the same material at any time. I feel that I have done my patient that real service which he or she had hoped to have bestowed.

This is why we say that "gutta-percha, properly used, is the most permanent filling material we possess."

Article VIII. Accepted Creed: A good gutta-percha filling, in its proper place, is better than a poor gold one.

Article VIII. New Departure: A poor gutta-percha filling, in its proper place, is better than a good gold one.

Some time ago a few of our Philadelphia gentlemen saw themselves on paper as saying almost too much in favor of gutta-percha; so they corrected it by publishing that they did not mean to say that gutta-percha was as good as gold; what they meant was, "that a real good gutta-percha filling, *in its proper place*, was better than a *poor* gold one." Meanwhile cases such as this were coming to our notice. Mr. J. G. W. had a gold filling introduced upon the mesial face of the left upper lateral, by one of our best operators. In about two years the filling failed. It was renewed, and in less than two years this second filling failed. We think we have a right to infer that both these fillings were good ones. Upon the occasion of a third visit, a gutta-percha filling was hastily introduced, to serve merely, *as was stated*, a temporary purpose. While yet the temporary filling was in place, the gentleman's partner (a patient of mine) induced him to call upon me. I was told the story. I examined the gutta-percha filling. It bore evidence of its hasty insertion, having overhanging edges. These I trimmed with a warm instrument, and asked him to give me the first proof of his confidence in his partner's recommendation and my judgment, by allowing the gutta-percha filling to remain, as it was a proper place for it. Already that filling has lasted longer than either of the gold ones, and, from appearances, it will last far longer than both the gold ones together.

This is also not an isolated case, and it is from such instances that we deduce "that a *poor* gutta-percha filling, *in its proper place*, is *better* than a *good* gold one"!

Article IX. Accepted Creed: Amalgam, per se, is a poor filling material.

Article IX. New Departure: Amalgam, per se, is an excellent filling material.

I do not mean to say that all you gentlemen think or say that amalgam is a poor filling material. But I do mean that this is the teaching of the most recent and accepted text-books and authorities. Read Taft, pages 93, 94 and 95, and you will see the "creed" of "Ann Arbor" and "Ohio."

I do not wish you to think, for a moment, that we regard amalgam as the *ultima thule*. By no means. While we recognize its great excellence, we also recognize its great deficiencies.

The relative durability of the three materials—gutta-percha, amalgam and gold,—is a question which I have been engaged upon for more than fifteen years; during which period I have endeavored to tabulate this matter by following the career of over *twenty thousand* fillings. Of course I recognize the impossibility of doing this with scientific accuracy. I admit that my result is merely a guess—but, gentlemen, I regard it as a *very close guess*—that, as the result of *average dentistry*, gold fails in fifteen years in 71 per cent. of its cases, and amalgam in 54 per cent. of its cases.

Understand me, this is *average* dentistry. It is not *poor* dentistry, for the gold efforts of such, you know, would not nearly reach such a standard. Neither is it truly "first-class" dentistry. If it were, I should be ashamed of first-class dentistry. But it is very close to what our profession, as a profession, is doing for those of humanity at large who come to us for services.

Now, when you reflect that all the good places, all the easy places, all the accessible places, as a rule (admitting all exceptions), are filled with gold; and that all the bad places, all the hard places, all the "forlornities," as a rule (admitting the exceptions), are filled with amalgam, *we* think that it does not tell so badly for amalgam; while we say for the gold, that it is a pity it is so "incompatible with tooth bone."

For gutta-percha, with 2,000 fillings of an average duration of eight years (these were in carefully-selected places, but all in *soft* teeth), the failure is but eight per cent.—160 failures, in soft teeth, in 2,000 cases, in eight years. These failures were mostly from disintegration of the gutta-percha. The action of the fluids of some mouths causes this material to soften, puff up and disintegrate. In such mouths gold is almost worthless for the average practitioner, except upon the articulating faces of the teeth; and in these mouths tin and amalgam have proven themselves our most reliable filling materials.

But you will say that gutta-percha fillings do not ordinarily last that way. That is because they are put in, definitely, only as temporary work, being removed in a short time to be replaced with work which is *called* permanent. The gutta-percha is almost always found (no matter how long it has been allowed to remain) *preserving the tooth* perfectly; and is frequently complimented by the operator for having done so, even while he is introducing his permanent filling, which, in truth, has often to be renewed sooner than would have been the case had he allowed his temporary filling to have remained.

Again, your instructions as to working gutta-percha, from the direction to "heat it on a porcelain or metal slab over a spirit lamp" (there is no surer method of ruining the material from over-heating) to the "holding of an instrument on the filling and pressing it till it is cool"—these instructions, I think, amount to nothing. Take a cavity in a lower second molar, first molar and wisdom-tooth in place. The cavity shall begin on the mesial face and deeply circumscribe the tooth, close to and partially under the gum, until it has passed along the buccal and distal faces and impinged a little on the lingual face. There is a place to fill! You all have seen such places, and they are excellent to fill with gutta-percha.

I have often listened to our good friend Atkinson, as, with streams of intelligence scintillating from his flashing eyes, and his whole countenance beaming with enthusiasm, he would expatiate on the wonderful workings of the mallet in the "hands of intelligence." But I tell you, gentlemen, it would take no less than *four instruments* in the hands of *four intelligences* to press in such a plug *till it got cold!*

Article X. Accepted Creed: The use of plastic filling materials tends to lower the standard of dentistry, thereby diminishing its sphere of usefulness.

Article X. New Departure: The use of plastic filling materials tends to lower that dentistry which has for its standard of excellence ability to make gold fillings, but very much extends the sphere of usefulness of that dentistry which has for its standard of excellence ability to save teeth.

This is where we rest our case. It is for the *salvation of teeth* that I have come to speak to you to-night. I have spoken only with that end in view.

I don't wish to speak of good, strong teeth. I don't wish, *at this time,* to tell you of my practice of to-day—what I am experimenting on, what I am tabulating. I have only to tell you what I have done, and what conclusions I have arrived at as the result of experience and long years of practice.

I do not wish to say anything to you of the teeth which you are in the habit of filling successfully, and, as we express it, satisfactorily, with gold; teeth of dense structure, whose cavities have walls so strong that you can impact a filling which lasts a life-time. But I do ask that you will gradually discontinue this packing of gold into teeth that are so poor, so frail, so unsubstantial, that it is, to say the least, doubtful whether the result will be creditable to your profession, or satisfactory to your patients. Remember, "$7 a year seems to me too much to pay for one tooth."

Commence, if you will, with those poorer and more miserable teeth which you would condemn to the forceps, and fill them with plastic fillings.

You will soon be agreeably surprised with your results in the new direction. You will soon find that much that has been told you by tradition and text-books has no *reality* in it. It is true that our results are produced more easily, comfortably and economically to the patients, but they will not complain of that. It is true that our results are produced with greater ease to the operator, and, for this reason, it is argued by our opponents that we do it from "laziness."

But I tell you that it is not from laziness. It is from a desire to lay aside the forceps. It is from a desire that our patients shall eat upon teeth the roots of which, at least, are in their jaws. It is from a desire that they shall be exempt from the infliction of artificial work. It is from a desire to extend the blessings which the hand of our profession holds to bestow. It is that we may be sought rather than avoided, that we may be extolled rather than decried, that we may be esteemed rather than censured, that rather than be feared, we may be loved and *respected.*

It is for this that I have worked; and blessed be God that he has so sustained and directed me that I have, every day, fresh cause to believe that I have gained the love of my patients and the respect of my professional brethren!

And now I find on the programme "Incidents of Practice." I supposed it meant "incidents of *my* practice," and so I have come prepared with a few to offer you.

Since twelve years ago (July, 1865) I have been keeping the money record of five sets of teeth, among the softest and frailest of those under my charge.

These were poor enough; decayed through and through, so that you could *string* five or six in a row; broken off, decayed down to and under the gum. From 1865 to 1877 (twelve years) these teeth have been kept comfortably in order. Not one tooth has been lost from the five mouths during all this time. That alone is something. But in adding up the aggregate of all their bills, and dividing the total by five, it shows that those mouths have been kept in order for less than $15 each per year ($14.80). This brings dentistry within the reach of many who have heretofore been deprived of its benefits. It brings it where it belongs—to be a blessing to the millions; and this is why we say that our practice "very much extends the sphere of usefulness of that dentistry which has for its standard of excellence ability to save teeth."

Prof. J. G. Richardson had in 1869 a right upper lateral, right upper central and left upper central decayed and needing saving. The lateral and left central were filled with gold; but the right central, being much worse than either of the others, my advice was asked in regard to it before it was filled. I said it would be best to fill it with gutta-percha. "What! a front tooth?" was the reply. "Why, yes! why not?" said I; "the man wants to save his front tooth just as much as he would a back one!" So it was filled with gutta-percha. In a few months from that time the lateral ached so badly during an entire night that, in the morning (I think it was on Sunday—I was not in the city), he called upon a dentist and insisted that it should be extracted.

In the course of time an ominous shadow passed over the left central, which told that its pulp had quietly died a natural death. It was entered, the pulp removed, and it is now doing good service as a pulpless tooth. But the worst of the three, the one that in 1869 most *needed* saving, *has been saved*, and is, to-day, a living, healthy, brilliant tooth. I saw it but a few days since. The filling is a little worn. I have an appointment with him, to add a little gutta-percha to it, on my return, when, with fifteen minutes' work, I shall start it off for another eight or ten years' journey.

Mrs. McG., left upper lateral: in this tooth two gold fillings, one $5, the other $6, lasted fifteen years. By the failure of both the tooth had become pretty badly decayed. *Twelve* years ago a gutta-percha filling was introduced for $4. With two trifling repairs, so trifling as to cost nothing, that filling has preserved the tooth perfectly.

Mrs B., eleven years ago, had a range of gutta-percha fillings introduced by a gentleman in Germantown. Her teeth were very frail. The fillings cost $25. In about two years, while visiting one of our Philadelphia gentlemen, she mentioned that it was two years since she had had any work done. She requested an examination, and was told, *very emphatically*, that there was some great mistake, that there was nothing but *temporary work* in her mouth, and that *she* ought not to have any other than the *very best*, which was *gold work*. Rather shocked at what she heard, she immediately made appointments, and had over $150 worth of gold fillings introduced. All the gutta-percha fillings were removed and replaced with gold, except one poor molar, which was stated to be "worth nothing except gutta-percha." In about two years from that time she visited my office at the recommendation of a friend, when I found every gold filling in such condition that my friend, Dr. Dixon, would have thought proper to have them removed. I said to her that the mistake had been made of filling her teeth with *gold*, when they ought to have been filled with *gutta-percha;* and, showing her the *poor molar*, said, "Do you see, this poorest of all the teeth has been filled with gutta-percha, and it is the only one that is not very defective."

Her eyes filled with tears as she told me the story of her four years' experience, and, as she finished, she asked what she should do. I suggested that she should call on and show the gentleman who did the gold work the result of his labors. This proposition being declined with a show of considerable spirit, I then suggested that she should let the first gentleman replace the defective fillings with gutta-percha, as he had had the good judgment to do in the first place. She said that he was in Florida and would not be back until some months later, and then asked if I would fill them with gutta-percha. I did so; and some three years after (she had gone to the far West) I heard that all was comfortable and doing well.

Just $200 for $25 worth of work, as one practical experience of gold fillings in soft teeth!

Dr. S. has three daughters. The eldest had centrals and laterals filled with gold at nine years of age. These fillings failed and were renewed when she was eleven. Again they failed, and at thirteen and fourteen years of age they were severally renewed. Under these fillings the pulps died, and the teeth came to me for treatment. She has four discolored, pulpless teeth.

The teeth (centrals and laterals) of the second daughter were filled when she was nine with malleted fillings. At eleven they failed, when hand pressure fillings were introduced. These failed when she was between thirteen and fourteen, and gutta-percha fillings were then introduced. At sixteen these are good, and all the pulps are vital.

The centrals and laterals of the third daughter were filled with gutta-percha when she was nine. She is now twelve, and all the fillings are just as they were when introduced.

These are typical cases of my gutta-percha results. Now for amalgam.

Mr. D., the great umbrella manufacturer of our city, came to me in 1859 with a left upper molar. It had been pronounced unworthy of salvation, and he desired ether as an anæsthetic. I suggested that it would be a very great loss to him, and proposed treating it and building on an amalgam crown. This was done, and to-day he calls it his "veteran"; and it has enlisted many a new recruit into my army of teeth "not worth saving"!

Mr. C. W. came to me, in 1857, with no teeth to spare. He was in young middle life (twenty-seven or eight), and had already lost many teeth. The tooth he came to have extracted was filled then with amalgam. He broke the crown off a *few weeks since.* I show it to you here. The roots have a full amalgam crown built on them now.

Since 1857 I have a list of a few over 500 patients who have come to me having lost already what teeth they could comfortably spare ; and from all these mouths, since that time, *not one tooth has been extracted.* Can any of you do any better than that with your $40 gold fillings ?

Now I have here three teeth which I have brought you on the *discoloration* question. I would have brought more, but *unfortunately* the patients are eating on them ! This one was in service 15 years ; this one for 17 years ; and this one for 22 years. Do you see that these teeth are *not one particle discolored ?* These fillings are made of Townsend's Amalgam, which contains only tin and silver. When such fillings leak sufficiently the tooth becomes discolored,—just as teeth become discolored when gold fillings leak ; but so long as they are tight, and in teeth of average quality as to structure, then discoloration is the *rare exception,* rather than the rule. I tell you, let an *average* operator introduce into one hundred *average* teeth fifty fillings of gold and fifty fillings of amalgam, and in ten years there will not only be more of the amalgam fillings doing good service, but among the fillings that are left there will be found more discoloration around the gold fillings than around those of amalgam. This is a startling statement, at least to some of you ; but I assure you that I do not make it loosely, but as the result of long and careful watching—as the result of many years of patient observation.

Again, your ideas of amalgam are based almost exclusively upon its workings in the enormous cavities of almost completely abandoned teeth. You select teeth that, you say, are "worthy of nothing else." Now, is this fair ? For if amalgam will save such teeth *even doubtfully well and exceptionally,* is it not worthy a trial in some of the *moderately sized* cavities of teeth of *somewhat better structure,* where, even yet, gold *occasionally* fails ?

It was said on one occasion, by my very good friend, Dr. Bogue, that he "viewed with admiration the pin-head cavities in centrals filled with amalgam by Dr. Clowes." Now I have viewed, I *think,* a great deal more frequently, with not so much admiration, the *enormous* cavities in centrals which *had become so* (I say this advisedly) as the the result of two or three consecutive gold fillings in each. For me, I would far rather have one of Dr. Clowes' "pin-head" amalgam fillings in one of my centrals, than to have one of those evidences of "first-class ability," such as carried death to the pulps of both centrals and laterals of the young lady whose case I have related to you this evening.

Nor, gentlemen, is this any unusual story of "accepted" dentistry. Front teeth, *par excellence,* are filled and refilled with gold, as the *best* that can be done, until pulp after pulp dies, tooth after tooth becomes discolored and crumbles away, root after root is extracted, and plate after plate is inserted. This is *stereotyped practice*, and I defy contradiction of the statement.

Now, gentlemen, I want to tell you one thing more which has grown out of our long work on plastic fillings—that we have not come before you prepared for only a small struggle. We are ready for the fight. We have opened our batteries against the accepted dentistry of the day. We are an aggressive party, and we purpose *insisting* that our "basal principles" shall be thoroughly discussed. We purpose making it *respectable* that teeth shall be filled with materials which experience has shown to be able to save them; and we purpose making it *not respectable* to fill teeth with materials which experience proves daily to be "unequal to the emergency." We purpose that "seven dollars a year for one tooth" shall be regarded as too much by *dentists*, as well as by *patients*.

Gentlemen, I have brought up thirteen hundred patients from childhood; and from the whole thirteen hundred mouths but *five* permanent teeth have been extracted, and these five teeth I have as the trophies of my success—not to show that my "scalps" are many, but to glory that they are so few. I do not say this to you boastfully. I could not do that; for my heart is too full of earnest, deep-seated thankfulness that it has been given to me to go in that path which has led to so much comfort for so many of my fellow-creatures. But I must plead guilty to a feeling of intensest satisfaction, as I think of the fact that every one of *mine* eats upon full, unbroken arches, above and below!

Gentlemen, make a beginning with the teeth you would extract, and treat them. Make *that* dentistry. Fill them with plastic fillings; and if, in twenty years, your experience shall have been that which mine has been, you will thank that great and excellent dentist, Elisha Townsend, as I thank him, for having had the hardihood to break the trammels of tradition and authority, in declaring that "teeth could be saved with amalgam which *he* could not save with gold."

WEDNESDAY, NOVEMBER 21st.

The Secretary read the following paper:

SOME EXPERIMENTS WITH FILLING MATERIALS.

BY HENRY S. CHASE, D.D.S., M.D., ST. LOUIS, MO.

A few words on the elementary principles of galvano-electrical action will introduce my subject, and will not, I think, need any apology. For the sake of simplicity, I shall speak of galvanic and electrical action as one, the electrical current or state being always the same, however produced.

To construct a battery, two substances, having different capacities for resisting decomposition, are used. They may be in close contact with each other, or connected by some other material capable of conducting an electrical current. Thus, if I tie together a piece of gold and one of tin, and immerse them in weak nitric acid (which dissolves tin), I have constructed a galvanic battery. The tin is acted upon and dissolved. The gold is not chemically attacked. The tin is dissolved more rapidly, and will lose more weight in a given time, while united to the gold, than it would if placed alone in the same acid. The gold, then, may be said to hasten the destruction of the tin.

If I unite tin and *silver* in the same acid, the tin will not lose as much weight in a given time as it would were gold its companion. Now, if the silver alone were placed in the acid bath, it would lose more or less in weight; yet, when united to the tin, it loses nothing. The silver, therefore, is saved at the expense of the tin.

Now take a metallic wire of moderate length, and fasten one of its ends to the gold plate and the other end to the tin, and replace the plates in the acid bath, keeping them now a short distance apart. Upon cutting the wire conductor, and attaching the two new ends to a galvanometer, the needle of the instrument will be violently deflected, say to 80 degrees. If the plates be now lifted from the acid, the needle will at once return to its former position; and if the plates be suddenly re-immersed, the needle will as suddenly be again deflected. From this it is seen that the electrical current is produced at the instant when the acid touches the plates. A repetition of the experiment, using silver in place of the gold plate, generates a current just as quickly, but the galvanometer needle will not go so far as 80 degrees, since the current set up by silver and tin is not so powerful as that produced by gold and tin. By this method a scale, comprising nearly all substances acted upon chemically by various solutions, has been so arranged that the substances at the two extremities of the scale produce the most powerful electrical action in connection with each other, the power lessening as the substances used are nearer each other in the enumeration. Gold, platinum or carbon will be little, or not at all, attacked by a simple acid, while zinc or tin will be quickly dissolved. Therefore these classes of substances will be far apart on the electro-chemical scale, and will form strong batteries.

In making a scale of electrical power (potential force), I place at the head those substances which are the most easily dissolved in acids. One constructed of such substances as are used for filling materials will be as follows: Oxychloride of zinc, gutta-percha, tin, amalgams, gold.

No current can be produced in the battery excepting at the expense of one of the plates or elements. The stronger the current, the more rapidly must one of the elements be dissolved. According to our scale, the most powerful current would be produced between oxychloride of zinc and gold, conditions being equal; for it must be remembered that the electro-chemical scale will be more or less altered, according to the liquid employed. Currents produced by the union of any two of the other elements would be far less powerful than that between gold and oxychloride of zinc, if the conductivity of the zinc were better than it really is. The weakest current would be produced by oxychloride of zinc and gutta-percha; this weakness being more marked because of the slight conductivity of the gutta-percha. Between tin and amalgam there would be a weak current. But between amalgam and gold, though close together on the scale, there will be a strong current, because they are, potentially, far apart.

But there is another element, not placed in the scale above, which imperatively demands recognition in oral electricity; that is, *dentos,* or tooth substance. This must be placed second in our scale, which will then read as follows: Oxychloride of zinc, dentos, gutta-percha, tin, amalgam, gold.

Of the two elements of a battery, that which is the most readily dissolved by the acid bath is called the *positive* element. That which is not attacked is called the *negative* element. If tin and gold are used, tin is the positive element, and gold the negative. If tin and dentos are employed, the dentos is positive and tin negative. In short, each element on the scale is negative to all above it, and positive to all below. Dentos, then, is positive to all the ordinary filling materials except oxychloride of zinc. Hence it also follows, that if tin suffers in contact with gold in the presence of acid, then dentos will suffer much more under the same relative circumstances; since the position of an element on the potential scale is determined by its relative power to resist the action of acids.

I made the following experiments:

Ten cubes of elephant ivory, of nearly equal density, size and weight, each having drilled through it a cavity of one size for all, were soaked in water one week, weighed, and the weight, in centigrams, marked on each. Two were then filled with gold foil, two with amalgam, two with tin foil, two with gutta-percha, two with oxychloride of zinc. These were then soaked in dilute vinegar for one week, and, the plugs being then removed, were again weighed. The loss in weight of each two was —cubes with oxychloride of zinc, 0 c.g.; with gutta-percha, 1 c.g.; with tin, 2 c.g.; with amalgam, 3 c.g.; with gold, 5 c.g.

Another experiment, with dilute lemon-juice as the fluid, gave the following losses: cubes with oxychloride of zinc, 1 c.g.; with gutta-percha, 2 c.g.; with tin, 3 c.g.; with amalgam, 4 c.g.; with gold, 6 c.g.

Many similar experiments gave varying results, according to the size of the cubes and the acids employed; but an invariable result of all was, *that the cubes containing gold lost a greater percentage than those containing other filling materials.*

The results of these experiments cannot be considered absolute; yet they may be valuable as indicating the relative safety of different substances when united to living dentos. It is true that living dentos may have some power to protect itself from galvanic action; yet I think it must be slight in cases where the electrical disturbance (in a water-tight plug) takes place only at the margin of the filling; for there dentos would be least likely to receive nutrition.

When a plug admits saliva between itself and dentos, galvanic action occurs at every point of contact between the plug and the dentos whenever the admitted fluid becomes acidulous. In many cases the self-protecting power of living dentos may be something more than theoretical; but, at a certain point of acidity, this force will succumb to attacks. This is exemplified by the fact that decay or chemical dissolution of dentos is continually taking place in the mouth. It is this weakness of resistance in dentos to dissolving principles which has rendered the dental profession possible.

The following experiment may be useful: Take two polished plates of steel precisely alike, each containing three holes of exactly equal size. Plug the holes in one plate with gold, and those in the other with tin. Place both in a dish of river water, of which there is barely enough to *wet the top surface* of the plates. At the end of one hour the plate containing the gold will be covered on its *upper* surface with rust, while that containing the tin will be still clean.

Conductivity is an important factor in galvanic action; the greater the conducting power, the more intense will be the action. Hence it follows, that a water-tight amalgam plug is better than an equally tight tin filling; for the tin is the best conductor. The electrical and heat-conducting power of our ordinary filling materials is as follows, silver being taken at 100: Gold, 60; tin, 30; amalgam, 10; gutta-percha, 3.

My deductions from the above experimental facts are as follows:

That gutta-percha will arrest decay, in acid conditions of the mouth, better than gold, and for a long time.

That oxychloride of zinc will arrest decay *perfectly* for a short time.

That tin is superior to gold for arresting decay for a short time in acid conditions of the mouth.

That amalgam plugs, *water-tight*, arrest decay in acid conditions better than equally tight gold plugs, and quite as well as tin.

That gold is the *worst* arrester of decay in *acid conditions.*

That a *water-tight* gold plug stops decay as completely as any other material, when the fluids of the mouth are *not acidulous.*

That a water-tight plug of any one material is as good as one of any other for arresting decay, in *neutral* conditions of the oral fluids, provided the *form* of the plug is not essentialy changed by attrition or accident.

That in acid conditions a bad conductor of electricity will arrest decay better than a good conductor.

That it is for this reason that gutta-percha arrests decay, although it does not, at present, make a water-tight filling.

DISCUSSION.

Dr. Barker (*Philadelphia*): I commend and endorse much that Professor Flagg said last night; but I must also claim that many of his arguments are specious. He has presented extreme points in his arguments, not only for, but against himself.

Let us look at the evidence presented to us by him. Now evidence, to be valuable, ought to carry something like conviction with it. We know that patients circulate from one practitioner to another, leaving each for some reason, often more or less trivial; and we know that they generally make some excuse for it to the new dentist. They will, for instance, point to a filling that was never put in by the individual in question, and call it his. I have seen such cases. Now this is not good evidence. But suppose that the patient's story was really true, and the filling was put in by the other man, and is now loose in the cavity; does that prove that the filling was faulty in the first instance? Not at all. No matter who does the work, if care is not taken of the teeth afterwards, those teeth will decay the same as they did before the fillings were introduced. It is useless to say that gold will not preserve this or that tooth. In the same individual, and at different times, teeth are under different conditions, and will resist decomposing influences in different degrees. Yet Dr. Flagg presents his arguments in the face of these and other conclusions equally demonstrated by experience, and in opposition to the opinion of the profession, here and everywhere, that gold is the best material for filling teeth. Certainly he ought to present very good reasons for what he says, and we should be able to confirm his conclusions, before we endorse them.

Dr. W. H. Dwinelle (*New York*): I have not heard all that has been said on the subject, but I know what ought to be said. Our profession has been attacked, and I think it is our duty to defend ourselves. It has been intimated that our professon is a failure; that we are doing much more harm than good. Much was said last night which tended to this—that our profession is unscientific; that we are doing our patients injustice; that we are using materials which mar and destroy, rather than properly restore and preserve; that we are making more failures than successes; that we are destroying teeth; that, in short, dentists do more harm than good! It was intimated that our failures in gold fillings amount to something like seventy per cent., even in the practice of good operators! I repudiate such an idea. I do not think that our failures with gold amount to over twenty per cent., and I doubt if they will figure up to ten per cent. I think a careful retrospect of our professional operations will show this to be true. I think we may look with pride and satisfaction upon the general results of our professional operations.

The only valuable deduction from what was said last night is, that we should be eclectic in our practice. Are we not already so? We all know that certain teeth can be best treated in certain ways; that some can be saved by amalgam, and some by gutta-percha. I have used amalgam all my life, and yet I believe there is no one who has more strongly advocated the use of gold for fillings than myself. It is a matter of record that I am the father of contour fillings. Still I use amalgam and Hill's stopping continually, and also osteoplastic. We are all eclectic.

I understand that Dr. Flagg claims he was among the first to advocate the non-removal of the last lamina of decomposed bone which overlies the nerve, and which, if removed, would cause the nerve to become exposed.

THE PRESIDENT: I think he credited that to Dr. Arthur.

DR. DWINELLE: I was ten years before Dr. Arthur in that matter, as will be proved by reference to an article in the *American Journal of Dental Science* for 1846, Vol. 7, page 74, from which I will quote as follows:

> "It is the experience of us all, that often, in removing decayed parts from the cavities of the teeth, notwithstanding we are safely enabled to displace all decayed and discolored matter from all surrounding parts, still we find that the *nerve* and its immediate vicinity is overcapped and protected with discolored bone, which needs but little license to call decayed. To proceed and remove every particle of decay from the tooth, would be to uncover the nerve, and surround the operation with difficulties which I will not at this time enumerate.
>
> "Under circumstances like the foregoing, after having thoroughly cleaned the walls, and such parts of the bottom of the cavity of the tooth as I can safely do without interfering with the nerve, I wash out the cavity with a solution of soda, and then proceed to fill the tooth in the usual manner, taking care, however, especially if the parts are much softened immediately over the nerve, to skillfully build an arch over that point, so as to enable it to resist the severe pressure of filling, finishing, etc.
>
> "Here, then, we have actual decay sealed up within the centre of the tooth, and that, too, in immediate contact with the nerve! If the first principle of the exploded theory of 'internal caries' were true, I have most effectually insured the certain destruction of the tooth, and *malpractice* is but a poor name to distinguish my operation. But my observation and experience, as well as that of several of my professional friends, proves to the contrary. . . . . . . The *decay* possesses no quality in itself of advancement, and when the cavity within the tooth is so completely and skillfully closed as to cut off *all* communication from *without*, it is as impossible for the decay to advance as it would be if the nerve were capped with bone of the purest whiteness."

DR. BUCKINGHAM (*Philadelphia*): In the paper of this morning, by Dr. Chase, it seems to be held that decay of teeth is proved to be caused by electrical action. I think it must be evident to all, that chemical and electrical changes will develop differently, according as the tissues are alive or dead. What would save a dead body would not have any effect upon a living one; and although the experiments made are doubtless exactly as reported, I have no doubt that their practical applications to oral changes are not as concluded in the paper, and that electrical currents are not set up in the mouth, nor does decomposition result from such currents. We all know that gold does save teeth in actual practice, and that it has saved them heretofore better than any other material we could get; and that it does not affect the margins as amalgam does. I do not claim that gutta-percha will not save teeth; but I think that general testimony will prove that it will not save them for fifteen or twenty years. I cannot get it to do so. I wish to protest against the assumption that electrical action is the sole cause of dentinal decay. The action of the electrical current is still a problem with physicists, and it requires much more investigation than we have made, before we can claim so much for it. Electricity can be produced in almost any way. Any and every chemical reaction will produce it, and so will a fly when he crawls on this pillar. Heat will produce it, as is shown in Professor Tyndall's book. These laboratory experiments, as applied to living tissue in the mouth, have little practical application.

In regard to the practice of leaving decayed dentine in the cavity, I will say I am intimately acquainted with Dr. Arthur, and, having heard him speak of the subject many times, can say that his idea was what Dr. Dwinelle has stated—that where there was a risk of exposing the nerve, he would leave the decay there, unless there was insufficient for the purpose.

As to Dr. Flagg's theories, I will say that he was not sent by Philadelphia to expound them. His claim that amalgam is superior to everything except gutta-percha for filling teeth, is altogether repudiated by Philadelphia dentists.

Dr. Palmer (*Syracuse*): As my name has been associated with the electrical movement in the "new departure," I wish to say a word in its favor. I have associated myself, fully and freely, with Dr. Flagg, in carrying out certain laws and principles; yet it is unnecessary for any of us to go to the extremes to which he has carried them. There are foundation principles underlying these things—certain laws which must be observed. Under the same circumstances the same cause always produces the same effects. Chemical action and the electrical current are so associated, that any change in one produces a change in the other. Thus, if chemical action be going on anywhere, if the contemporaneous electrical action is stopped, the chemical action ceases also; and, where there is no chemical action, it will instantly be generated by electrical action being there induced. Place, for instance, a loose piece of gold in a dental cavity in which decay has been going on. Upon the introduction of the gold, the circulation in that cavity is vastly accelerated by the increase in electrical action caused by the metal. This increase in activity of the destructive action is just in proportion as the metal introduced is a conductor. Now gold is the best conductor among filling materials.

Dr. Chase, in his paper, comprehended always the acid condition of the oral fluids. When gold is introduced in the cavity, these fluids not only become acid, but are maintained in that condition by the presence of the metal; that is to say, gold sets up a decomposition which supplies the elements that soften the calcareous portion of the bone, leaving the cartilage, and producing sensitiveness or tenderness of the teeth. You all agree that a tooth is not in a very bad condition when it loses a gold plug. The reason is, that the plug is really an injury to the tooth, because it supplies an acid condition of the fluids, and does nothing else to atone for this misdemeanor. Tin has a property which does not belong to gold. In its oxidization it produces a neutral or alkaline salt, which checks the electrical action. Gold is not oxidized, and hence maintains the electrical circulation in acid activity. If you can bring gold everywhere into such exact contact with dentine as to prevent circulation of the fluids between them, then chemical and electrical action ceases.

I know that what I have said does not change your opinions; yet you will admit that there are cases in which gold is inadmissible; and if I can give any facts to aid you in diagnosis, I will have contributed my mite to professional knowledge. It is true that there are cases in which, from the desires of our patients, we must use gold. I am often thus compelled to use it, when I know there are better things for the case. At such times I always explain the situation to the patient, and let him know what to expect. When I must use gold, and apprehend not being able to control the chemical action, I simply place a layer or two of tin upon the exposed points, and then proceed with gold in the usual way. Then, if the tooth sets up an action which would tend to undermine the filling, the tin is quickly attacked, and supplies that chemical check of which I have spoken. This procedure saves many teeth for me.

Some have claimed that in using amalgam we lower the dignity of the profession. I think the true dignity of the profession lies in the knowledge of how to save teeth, no matter with what material. If teeth can be saved by amalgam, let it be used; and if gold is the proper material for the case, then use that metal. But it is certain that teeth cannot be saved by any method or material which bids defiance to sound laws and principles.

Dr. Bogue (*New York*): I would like to ask Dr. Flagg a few questions. As I understand him, he states substantially that he feels able to save all teeth; at least, that he has had a loss of only five teeth, from 1,300 patients, in twenty-two years.

Dr. Flagg (*Philadelphia*): So far as I know, the statement is correct. So far as I know, every statement which I made last night is as correct as

I am capable of making statements. I have been grossly misconstrued this morning. As to leaving decay in the cavity, I say Dr. Arthur did promulgate certain teachings, and that Dr. Jack and myself were the only two who assisted him openly in the matter. I said that between 150 and 200 of Dr. Townsend's families came to me at his death; for I kept account of the number until it amounted to 153. I am willing and anxious to take any mouth, or set of mouths, which have been abandoned by first-class practitioners.

Dr. Bogue: Then my inference is correct?

Dr. Flagg: It is correct.

Dr. Bogue: Must I understand you to mean that, in the cases of 500 patients, the plastic fillings in twenty years were so satisfactory, that not one tooth was extracted, as far as you are aware?

Dr. Flagg: Yes, sir.

Dr. Bogue: Were you in the habit of using gold before the 250 experimental cases?

Dr. Flagg: All the time.

Dr. Bogue: Yet you have since used gold (at least Morgan's crystal gold) to a considerable extent, and for a somewhat extended period of time?

Dr. Flagg: No, sir. I have changed my practice.

Dr. Bogue: If you had a reliable method of saving teeth, why did you change from gold *foil* to amalgam, then to *crystal* gold, and back again to amalgam and other plastic fillings exclusively?

Dr. Flagg: I did not have such a method. Those teeth had been filled with gold over and over again, by myself and others.

Dr. Bogue: When Dr. Flagg asserted last night that we, as a profession, accept certain doctrines as our dental creed, I take it for granted that he intended to indicate only his understanding of what the profession accepts.

Dr. Flagg: That is my meaning. I said so in a Pickwickian sense, and I ask if I am not correct? There was no negative last night.

Dr. Bogue: The gentlemen here say that they do not so understand the dental creed; that while, ten years ago, no one used amalgam, to-day they do use it, in certain cases. Amalgam fillings are now put in by those who are recognized and acknowledged as our best operators.

There is one argument in favor of Dr. Flagg's theory, in the discussion of which you will, perhaps, allow me to use a personality. Our friend Dr. Webb will be acknowledged by every one here to manipulate gold elegantly. We all accept his view, that the mechanical adaptation of the ideal human tooth to the purposes for which it was designed is admirable. Dr. Webb, then, restores broken-down dental arches to the ideal condition of perfection. He uses gold. He deprecates plastic fillings. Yet Dr. Webb tells us, that after the performance of every one of these elegant operations, he sees how he could have improved it; in other words, that there is a defect in every operation he performs. Gentlemen, that is a long sermon to me. The strain upon the operator who does such work is such, that no conscientious dentist, possessing those senses which such work demands, can do it continuously and live in health. The strain upon both patient and operator is too great in habitual practice of that kind.

It is undoubted that there are teeth which can advantageously be filled in that way. But, according to extremist doctrines, all teeth that cannot be so filled are doomed to the forceps. But this occasions a great loss. How can we prevent it? What shall replace the forceps for broken-down teeth? I think it yet remains to be definitely settled how much good, in these cases, this "new departure" can afford us.

In regard to the relative durability of gold and amalgam fillings, I think no one of us dares to decide, at this moment, in view of Dr. Palmer's theory of electro-chemical action. Still, there here appears, opening before us, a field for inquiry and research which will not be allowed to lie fallow. Last evening I examined the record of the first amalgam filling that I ever put in. It was introduced in 1866, into a tooth of poorly organized structure, to replace a gold filling put there by one of the best known of our New York operators. My work was crude, for I had to learn, from Dr. Cooke, how to put in the material; yet that filling is still in its place, and has not required the least repair since it was introduced. The tooth is slightly discolored. The gold fillings in the same mouth have been many times repaired.

Dr. Flagg, some years ago, allowed me to spend some days in his operating room. During that time he showed me how he preserved the poor roots and shells of teeth, and made them valuable with comparatively little trouble or expense to either his patients or himself. From that time to this, I have never, that I can remember, extracted a tooth which was not so loose as to be capable of being taken out with a string, except for regulating purposes—making an exception, of course, of roots. I am very happy to make my acknowledgments to the gentleman for the instruction he then gave me; for I have been enabled to make many poor and otherwise valueless teeth serviceable.

If Dr. Flagg had pronounced himself as in favor of plastic fillings in all cases where gold is inadmissible, rather than to extract the teeth, I could have heartily accepted that doctrine; for its correctness was forced upon me years ago, and it has since been acted upon. But I am not yet prepared to accept any plastic filling as a substitute for gold, in many, and, perhaps, the majority of cases.

DR. SHEPARD (*Boston*): I have been, for years, convinced that the dental profession, as now constituted, utterly fails to meet the universal demand for saving teeth—the teeth of the multitude. I do not think this arises so much from defective methods, as from the fact that those methods are so complicated and expensive as to be entirely beyond the reach of the greater part of the population. From the very nature of our usual operations, this cannot be remedied; and on that account I welcome, rather than condemn, any such effort as that made last night. I care not by what method or by what material teeth are saved, so that they are saved in the end. I have nothing but "God speed" for any man (no matter how much he and I may otherwise differ,) who is working in that direction. It is of little importance what his methods are, or whether they are or are not presented in accordance with generally accepted views.

However, I think few of us would be willing to attempt the *finale* of gold fillings as was last night explained. As to statistics, I think none are trustworthy, from a scientific point of view, except when they are collected from the observer's individual practice. In examining general dental statistics, various sources of error are observed. The statements of patients cannot be at all relied upon. A reference to our records often corrects statements of our own patients as to our own fillings. Even the operator's own remembrance cannot be implicitly relied upon; and hence the great value, to us, of our record-books. I question the gentleman's statistics, and I do so without detracting in the least degree from my great personal respect for him. I respect the care and labor he has put into this subject; but I question the accuracy of all the observations he detailed to us, except those made by himself; and, of these latter, I question all which he has not recorded.

The way to get at this matter scientifically, is for each man to keep his own records carefully, and from these individual and recorded operations to tabulate generally. The truth comes from such tabulations.

Dr. Webb (*Lancaster, Pa.*): In regard to Dr. Bogue's statement of the exertion and strain required in introducing gold fillings, I would like to say that the electro-magnetic mallet has altogether taken away every such characteristic from the work. There is now very little more labor in impacting gold than there is in writing a letter.

As to the leaking of gold fillings, and the consequent electro-chemical action induced, I believe that if the gold is so put in as to prevent leakage entirely, no such action will occur. This should teach us to introduce our fillings more carefully and thoroughly. Such as are unable to properly put in gold fillings, may find it better to use a more plastic material; but all should endeavor to do nothing but the best work. Time should not be considered when excellence of operations is in question. Perfection should be the aim of every operator.

Dr. Bronson (*New York*): In the presentation of the electro-chemical theory, it seems to be inferred that electricity, *per se*, is a destructive agent to the teeth, and much stress is laid upon the action of the ordinary galvanic battery, in order to prove this point. It is true that a plate of carbon and one of zinc, in an acid bath, will produce an electrical current; but only when they are connected by a conductor. Previous to this contact (if the plates be of pure metal,) there exists only electrical polarization, which will be converted into action when the proper conditions are complied with. It is generally admitted that all chemical action produces electrical polarization—which means, a capability of electrical action; but it remains to be proved that electricity, in this state, is a destructive agent, or that it assists or increases chemical action in any way.

Dr. Clowes (*New York*): I deprecate extremes always. I do not believe that we should use any one filling material to the exclusion of all others, even if that one be a good material. Each one is valuable in its place. Plastering is good in its place; but if nothing but plastering is done, this profession will lose not only its dignity, but its value.

If there is anything I take pride in, it is the science of dentistry; and I want that science to be as advanced as possible. But, gentlemen, if my work in gold, during the last thirty years, should be taken away, I am afraid I should not take so great pride in my profession as I do now. If I have done anything particularly good, it is in gold. Gold-work is æsthetic dentistry. A filling should not only be beneficial—it should be also ornamental. I use gold, amalgam, tin, osteoplastic and gutta-percha, and I save teeth with each of them.

Here is a gentleman of great experience, who tells us of many failures in gold. It is not on account of the material, nor from its imperfect application. It certainly is not from want of labor in the application. There are other things that cause these failures. An eclectic use of filling materials must be combined with separation of the teeth, in order to stop this succession of failures. Separation is the key to success in this matter. It does away with chemical action. There is no need for failures, of which there will be none if teeth are separated.

Dr. Brockway (*Brooklyn*): I have not yet heard this morning what I consider a fair statement of the position of the advocates of the "new departure." It has been charged to them, that they advocate the use of plastic filling materials to the entire exclusion of gold. I understand them to mean that a tooth can be as certainly saved by a plastic material—say amalgam—as by gold. I am led to believe that this is true by an experience and observation of many years, not only in regard to my own practice, but that of my friends. Gold, we know, requires certain conditions for its proper and successful use. The essayist claimed that with other materials some of these conditions can be dispensed with. A plastic filling is more adapted to inaccessible cavities. It can there be used with more facility, and consequently gives better results. But then, gold fillings by the best operators and in the most accessible cavities do sometimes fail. Some of these failures can be accounted for on the principle of imperfect manipulation, but all of them cannot be so disposed of. The electro-chemical or the new departure theory does account for these, if it is accepted as correct; and I believe it has a basis of truth.

A very powerful argument in favor of plastic fillings is, the advantage which is procured to the community at large by the use of an easily manipulated and comparatively inexpensive material. It is not denied that gold fillings can be introduced in many cases; but unless in these cases there is some good reason why gold should be preferred to any other material, I hold that it is our duty as honest men to practice eclectically, and discard it in those positions where it would or might do harm instead of good.

Dr. Daboll (*Buffalo*): I wish to protest against the assumption of the essayist of last night, that the accepted creed of modern dentistry countenances the saying that "gold is the *best* material for saving teeth." The profession do not think so—certainly not those west of New York. Nor do the dental publications of the last ten years indicate that gold is the best filling material in all cases. Nor do the writings of our best men, in that time. These have uniformly stated that they used gold only when they could do so to the best advantage, and that they used other things when other things would attain the object better than gold. Such has been my practice. Neither is it correct to say that dentistry holds that either contour or separation is necessary to the salvation of teeth.

The following paper was then read by the author:

THE RELATION OF THE SCIENCE OF PHYSIOGNOMY TO MECHANICAL DENTISTRY.

BY C. A. MARVIN, D.D.S., OF BROOKLYN, N. Y.

It was my privilege, during the last summer, to read a paper before the Second District Society of this State, and to repeat, by request, the same paper before the State Society of New Jersey, on the subject of "The Comparative Importance of Mechanical Dentistry"; and it is with no desire to assume to myself the name and character of champion of this special branch of dental work, that I have chosen another phase of the same subject for my paper to-day. But it is because of the need which, to my mind, exists, of urging a higher standard of excellence in this department—a department which is too much neglected, too little studied, too imperfectly understood.

I wish, therefore, to offer a few thoughts upon the general subject, before considering the special one which is to receive attention in this paper.

Mechanical dentistry has been buffeted and ignored in turn; has been decried by those who have thus shown themselves to have failed utterly to sound its depths, or comprehend its resources—nay, has been wounded in the house of its friends.

Some of the latter object to the name "mechanical," preferring "artificial"; and openly assert that the former implies a lack of scientific attainment. Then, in proof of the assertion, they proceed to characterize a mechanic as a mere imitator, possessing no genius, no originality, merely pursuing a rut created for him by some forerunner. This, it need hardly be said, is an untenable position.

There may be imitators among the craft, and because they call themselves mechanical dentists, does it follow that all mechanics are imitators? If a bungler hang out a sign and call himself a dentist, are we instantly to repudiate the name, and say that a dentist means a bungler?

Men who have no capacity are found in every profession, men of moderate ability in still larger numbers, while the men of distinguished mark are comparatively few. Are they who honor their profession, therefore—who occupy the front rank, if you please—warranted in changing or despising their professional name, because, forsooth, there may be those in its ranks below them? And are names to be coined to suit every grade? What if there be imitators? All are not imitators, or there would be nothing made to imitate. And what other name than mechanics can be given to those who created the original which imitators follow? What but a thorough knowledge of mechanical principles, of dental mechanism, enables one to create an original? What but mechanical principles underlie all the manipulative operations of our profession? Without them who could successfully build up a tooth? Who make a useful contour filling? And in this very department, who but a true mechanic can cope with and overcome the many difficulties that attend the insertion of a satisfactory artificial denture—difficulties unforeseen, inherent in each individual case? The objection is unfounded, unworthy, and does much harm. When gentlemen of maturity in the profession, who have been for years identified with this very department, and have made valuable contributions to it, are ashamed of the name, what can be expected of young practitioners and students?

And, further, as a knowledge of mechanical principles is necessary to success in this department, and the putting of these principles into practice is necessarily the work of a mechanic, if the name "mechanic" is deemed ignoble—is treated as ignoble—is dodged and shirked by those who ought best to appreciate it—the natural result is loss of respect for that branch whose name is despised. And when men lose respect for their calling—when men become ashamed of the name of their vocation—there is an end to advancement. More than this, decadence is sure to follow, and that swiftly. This is a calamity when the vocation is one which affects the public, as is the case with that now under consideration. The services of the mechanical dentist are not of imaginary need. The doctrine of a growing perfection of the human race, a reducing proclivity to disease and decay, and hence a lessening need for those arts which repair the breaches in the human frame which time and attendant circumstances always produce, finds no more confirmation in the history of the race than in sacred revelation. But if it did, the fact would not justify any neglect of this department more than any other, since the operative would be proportionally dispensed with, its office also being to repair the ravages of time. If it is claimed that the increasing success of preventive, and the enlarging efficacy of curative treatment, warrant the expectation that by and by no natural teeth will be lost, then I am compelled to announce my belief that such a claim is a fallacy. Not that I undervalue either preventive or curative treatment, or am unmindful of the great strides of advancement made in both—I protest here and always against being so understood. I know what has been accomplished, and am both proud and grateful on its account. I am proud that our profession can justly claim so large additions to its credit side in the great account of beneficence to man; and grateful both to Him who gave the talents, and the men who have exercised them for the working out of such results. But while admitting the progress made in the prevention and arrest of decay in natural teeth, and in the cure of the diseases of the oral cavity, which, unchecked, would surely destroy those useful organs, the sad fact remains that teeth are lost by hundreds and thousands; that cases in the hands of our best practitioners do baffle skill and defy treatment; and the expectation that this state of things will speedily or surely come to an end, is a fallacy. The repression or neglect of the mechanical branch of our profession, in consequence of this expected millennium, is the sheerest folly.

We are in danger of drawing a false inference from this reasoning, and the necessity for it which unfortunately exists, viz., that there is naturally a conflict between these two departments.

Let us not be deceived. There is no natural conflict between them. Harmoniously dwelling together, two members of one curative family, one supplements the other, performing its distinctive offices when those of its sister healer are no longer effective, and so together working for the common good.

A conflict *can* be precipitated, if men are unwise enough to work for such an end. The happy family can be broken up, its members can be arrayed one against the other, discord can be introduced and a perfect antagonism established; but it is an unworthy object for which to strive. It is a disastrous result to achieve, whether done intentionally or inadvertently. The public must suffer as a necessary consequence of the strife.

Each department, to advance its own interests, will decry the other, will seek to destroy confidence in the other, will endeavor to put the other down that it may rise, will argue against the other for its own personal ends, to the confusion of the public and the disgrace of the profession.

The two departments belong together in the same office. A thorough understanding of both should reside in the same mind. Both should be embraced in the one head which decides for the trusting patient what is for his best good.

A knowledge of either without the other leads to imperfect results, and should be deprecated by every one who admires a well furnished mind and a well rounded intellectual development, and desires for his profession the elevating influence of such minds.

Prejudice is the parent of blindness, and blindness of the worst sort—willful blindness—the willful closing of one's eyes to the merits or demerits of the thing against, or for, which one is prejudiced. Nothing is more common than strenuous advocacy of men or schemes concerning the real worth of which the advocates know but little, but are influenced mainly, if not solely, by personal favor; unless it be the equally strenuous denunciation of measures and men, by opponents equally ignorant of their demerits, who also are governed solely by prejudice. It is an every-day experience in life. What men dislike they condemn, what they like they applaud, irrespective of intrinsic qualities. Such verdicts are unreliable, and many suffer from them. Many worthy causes are hindered, crippled, defeated by opposition arising from just such an irrational sentiment. Prejudice—the prejudging of a matter—forms its opinion in advance of any examination—indeed, utterly cuts off examination, and the thing judged, and those affected by it, sustain an injury.

Apply this too common mode of judgment to our subject, and the way will at once be opened for the consideration of the special thought which this paper is designed to unfold.

If a prejudice is created against any department of our profession, those who imbibe the prejudice will at once cease all efforts to explore that department, and will remain in ignorance of what it contains. It is only by study that the arcana of any science are discovered. The non-student wonderingly asks if, indeed, there be any arcana! Prejudice answers, "None worthy the name," and, accepting the reply, he remains the non-student still. And when the arcana are displayed before his listless eyes, he heeds them little, for he has not learned by study to value the results of study, while he has learned to condemn without knowledge, and to refuse knowledge of that which he has condemned.

To such I do not speak; but to those who are, or who are willing to be students; to those who value knowledge wherever it is found; to those who are honest in their opinions, and ready to enter into any field of investigation from which may be gathered materials for correcting false judgment and forming new which shall be able to stand the test.

I have alluded to the resources of mechanical dentistry as not being appreciated by those who affect to despise it. "And pray what are its resources?" says one of those who believe in its certain and appropriate decline. I answer, they are too many and far-reaching to be treated in a single paper. I have, in former papers, enumerated and discussed some of them. I shall, in this, confine myself to the consideration of one element which enters into the complex science of mechanical dentistry. I refer to physiognomy, and its relation to this specialty of our specialty.

The fundamental principle of physiognomy is, that the prominent traits of human character are represented by distinct styles of feature. It teaches, therefore, first, last, and always, the study of the human face. I assert, and hope to be able to establish, that such a study is essential to eminence in the department which I am considering. For four years past it has been my practice to urge upon students whom I have taught from the professor's chair this branch of study—the study of physiognomy. I cannot keep silent while my efforts in that direction are being neutralized by what the same students see, hear and read of the low estimate put upon this noble art by many practitioners. Silence would be encouragement to forsake the path I pointed out to them. I intend, therefore, by voice and pen, to clear myself of the guilt of neglect, by asserting what I believe to be the truth, and what I believe will be found to be the truth, though, perhaps, not till the discovery shall be attended by bitter regret that their eyes were not sooner opened.

In starting out in this new sea of inquiry we need a chart. We have it—the face. How many gentlemen now before me have ever made the human face a subject of critical study? How many are there who, with closed eyes, can correctly describe the features of their intimate friends?

Perhaps you may remember the color of the hair and eyes, the shape and size of the nose and mouth, if these features are at all peculiar; but tell me if the eyes are level, if deep set, transparent, round, near together? Are the eyebrows arched, horizontal, angular, continuous? What is the shape of the nostrils? Is the nose in the middle of the face? Is the angle formed by the right cheek and right ala equal to that at the junction of the left cheek and left ala? How are the lips in respect to fullness, shape, flexibility? Is the vermilion border hidden or visible when the lips touch? Do the corners of the mouth turn up or down, or are they straight? Are they clearly cut, or surrounded by a small wrinkle?

To come nearer home, what is the shape of the teeth? Are they broad and short, broad and long, touching laterally, narrow, tapering, or slightly separated? What is their color? What their degree of projection?

Who can pass such an examination? Very few, I venture to say. What does this prove but that we are careless observers of the territory wherein lies our field of labor? We do not know its characteristics. "Well, and if it be so, what harm is it? Where is the need of knowing these details?" asks one. Considerable need, if you wish to fill the bill which specifies a complete dentist. And I will try to show why.

Let no one hastily exclaim, "There is no force for me in any argument founded on physiognomy, for I do not believe in physiognomy." Friend, give me your attention, and you will see that the principles on which I stand in this paper are principles which, though forming the foundation of a science called physiognomy, are *intrinsically* true, and of universal acknowledgment. It is with such principles, and only such, that I deal this morning. I advocate no *ism*—I have no pet science, no favorite scheme, to advance here. I came to speak on what concerns us all; and I propose to place myself on sure ground, and deal as honestly as I may be able with my subject, with myself, and with you.

The fundamental idea of physiognomy is of spontaneous origin, growing out of the remembered impressions made upon the mind by different classes of features. We have all felt this in our own experience again and again. Certain faces are attractive, certain others repulsive. Some inspire respect; some, fear; some, disgust; some, reverence. These varied effects of varied features having come to be noticed, a science, founded thereon, was constructed, and has had its ardent supporters. It is not necessary to go into all the details of the constructed science. It is not likely that all of us could give our assent to its remote particulars. I certainly could not. But this admission of the possible incorrectness of some of the deductions of the science does not at all weaken the argument I am making. It rather strengthens it; for the fundamental idea, which is acknowledged, is the basis of my argument, and it stands thereon, visibly receiving no support from the ingenious framework of the created science.

We go just far enough into this field to gather what will be of service to us, and we take that only. I have said that certain features produce certain impressions, and these vary as the features vary. No one can deny that.

My next assertion is, that this is not a question of beauty, that these impressions do not accord with nor proceed from the degree of beauty in the features, necessarily. We sometimes see faces which are faultless as respects beauty, but which, nevertheless, produce an unpleasant impression upon the beholder. The exterior eye may be pleased, but the inner sense is offended. The reverse of this is also equally true. It is not necessary to multiply words in proof of this. What the common experience attests needs no argument to establish. But for the cause of such apparently anomalous facts we must look deeper. It is found in the traits of character which are discerned behind the features.

The department of mechanical dentistry has to deal with one of these features; one of the most important; one in which more changes can be wrought by the hand of art than in any other; each one of which changes creates a new expression, and sets forth a different interpretation of character.

In order to produce the proper expression, and make a mouth that shall in its indications be true to the other features, and to the character, this science of features must be understood in the true meaning of that word, viz.: to *stand under*, and get a clear perception of the groundwork of the thing. Knowledge of one feature is not enough. All together compose the face; each does its part. In order to know the part which any one contributes, the parts of all must be known. Harmony in music is the result of several different tones. If one is wanting, the harmony is imperfect. If we are asked to supply the missing tone, or missing chord, we at once examine all the others, to determine what will complete the harmony and bring out the idea of the composer.

One very obvious end to attain, in the mechanical treatment of an edentate mouth, is symmetry. How can that be attained? By knowing what symmetry in the human face is. And this education can only be acquired by a careful study of the science of physiognomy. Some directions for pursuing the study it may not be amiss to note.

The face should be studied, first, feature by feature, that we may know their boundaries, the general resemblance between the same features in different faces, and their specific characteristics, and be able to describe them.

Secondly, the face is to be studied with special regard to the relation of the features to each other, to the end that we can determine natural facial proportions.

Third, study it as a whole, with respect to general symmetry. What is symmetry? A just correspondence in all the combining parts. This is learned by comparison. Some faces seem perfect in this particular, presenting nothing to offend the eye. Take such as models. Note the relation of feature to feature; of each feature to the whole; of the details of each feature; what modifications in respect to size and shape, in any one, might attend certain modifications in some other, without loss of a pleasing effect in the whole; what compensation, if any, can be found in some one particular for an imperfection in some other. Such an analysis of the human face, faithfully pursued and oft repeated, will give one an acquaintance with it which cannot but be valuable. This will be information worth possessing.

So far, the study has been of the face as a specimen of Nature's mechanism—an external study, having beauty and symmetry as its spur and end. Nor can the importance of this kind of study scarcely be overestimated. Its application is an every-day necessity. Without it, how can a man restore a feature that is distorted or destroyed? How can he make of a mouth (which, when it comes into his hands, is only a cavity, bounded by walls and overhung by curtains of flabby flesh, which waver unsupported and expressionless,) a feature which shall correspond with those with which it is connected, and restore harmony to the face? He does not know what he has to do, and is not competent to say when it is done. How dares such a man consent to undertake a task like this? It is criminal presumption to attempt it. It is touching the ark with unholy hands, and it is time the public so understood it.

But there is more than this. Another step in our study brings us into the region of more precious, even sacred considerations.

The human face is the index of the soul. The feelings therein, the qualities thereof, are inscribed there, and when the writing is defaced and one is commissioned to restore it, let him consider well what he does, lest he commit no common crime by perpetrating a fraud upon Nature.

Does any one think I speak extravagantly,—that I assume for the dentist a solemnity of responsibility not warranted by the issues involved? I ask his attention.

A round, finely arched forehead indicates a wise, well-developed character.

All disproportion in the lips is a sign of folly and lack of balance in mental qualities.

Now if you deal with a patient so that when you dismiss him from your office, a glance at his forehead, which nature made, gives the impression of a noble mind, and a glance at his mouth, which you made, gives the impression of an unbalanced one, have you not committed a wrong against the man and against Nature?

If a man brings into your office a perpendicular forehead, denoting deficient understanding, and wide open eyes, the white beneath the apple distinctly seen, indicating a timid, phlegmatic temperament, and you give him a mouth which is evenly closed, well defined, unconstrained, a sign of consideration and firmness, haven't you written the word "contradiction" in unmistakable characters on that man's face? And when that expressive appearing mouth opens in speech and produces only disappointment, because the thinking machinery within does not accord with the speaking organs without, is this nothing? The man is a fraud, and his dentist has made him so.

If a person with a straight nose, which represents gravity of disposition, be supplied with a mouth with the corners turned up, denoting levity, is no wrong done?

A lady of an amiable disposition, as indicated by the softer shades of blue in the eye, a finely chiseled nose, with nostrils pointed above and rounded below, and slightly arched eyebrows, may be converted into a horrid monstrosity by an inappropriate mouth. A projecting lower lip will make her appear sensual; tightly drawn lips, severe, sarcastic; swollen lips, gross and vulgar; lips with an opening in the middle when closed at the sides, cold, unmerciful; ends of lips drawn down, contemptuous and void of love.

A retiring disposition may be made to appear bold; a delicate one, coarse; a sympathetic one, despotic.

Masculinity in the face when the mouth is closed, may be suddenly transformed into femininity, when the mouth is opened, and narrow, delicate teeth are seen. And, on the other hand, a beautifully feminine face may be made hideous by large, square, masculine teeth.

Weakness of disposition may be written upon the lips if the teeth are too far back in the mouth, affording the lips no adequate support. Again, a look of conscious superiority not at all indicated by the eye or nose or residing in the disposition, may result from a certain prominence in the upper lip imparted by the teeth. A good-natured, silly expression comes from a flattened and broadened mouth. Now, unite this with a forehead of dignity and eyes of firmness, and the result is not agreeable. Illustrations might be multiplied *ad infinitum*, but these must suffice—and, indeed, I think enough has been said to justify the assertion that a responsibility of no common order rests upon the dentist who has to supply, by artificial substitutes, the place of lost natural teeth, and create a feature which shall bear its appropriate part in establishing that external index of the character which the face is expected to be. And enough has been said, too, I think, to show the advantage, nay, the necessity, of becoming familiar with the principles of physiognomy, in order to meet this grave responsibility.

This responsibilty is threefold, comprising the relation of the service to the patient, to Nature, to the profession.

To the patient, that he be justly dealt with; that his face be made symmetrical, the handwriting thereon consistent and reliable, that it may be the true index of his character.

To Nature, that her testimony be not contradicted, and that her work be not profaned, while her indications are appreciated, and brought out into positive, vital form.

To the profession, that discredit be not cast upon it when it deserves honor, that it be not made to appear inadequate to the demands upon it, that it be not placed on a low grade, in point of respectability and worth, when its place is a high one.

Another branch of this department, of great importance, can be only mentioned in this paper; that of correcting irregularities of the natural teeth, in which close scrutiny, good judgment and a high order of skill are necessary.

I have not exhausted the subject, gentlemen, though I have consumed the time which I may properly take. The subject is wide-reaching and well nigh exhaustless. If the suggestions I have thrown out incite to a closer examination of it, a higher and truer appreciation of its resources, its responsibilities, and a conscientious and energetic effort to make real and tangible what is seen to be contained within it, this paper will not have been prepared in vain.

Gentlemen ! brother dentists ! let us rise to our proper plane. It is the plane of scientific attainment, of liberal views, of professional completeness. Let us throw prejudice to the winds; break every shackle that would confine our thoughts and our efforts to a narrow circle; and listen to every voice that invites us to large fields of investigation.

A noble profession numbers us among its members. A profession whose field of labor is wide enough, whose duties are intricate enough, whose resources are ample enough, whose possibilities are extensive enough, to satisfy and engage the highest human talent. A profession triple in its composition, combining an operative department, a mechanical department, a surgical and therapeutical department. Each one of these has its own distinctive features, its own field of operations, its own special admirers. But let them not be divorced. Let them not be put in antagonism. Let them not be odiously compared. Each one is important; each essential; each noble. Neither can be dispensed with without loss. Neither can fill the office of any other. Each is supreme and alone in its sphere.

To decry either is to display ignorance of its merits; to ignore either is to manifest a disregard for the ills it is to cure, which is unbecoming a professional man.

While some find the particular practice of the operative or surgical department especially congenial to their taste, let not these forget, nor they who prefer the mechanical branch fail to believe and maintain, ever and unfalteringly, that of all the men who are summoned as healers of the infirmities of the flesh, no one has a juster title to respect and to honor than the conscientious practitioner who, with a full sense of the responsibility resting upon him, and in a manner that accords with the spirit and resources of his specialty, performs a successful operation in mechanical dentistry.

Dr. Kingsley then read the following paper:

MECHANISM OF SPEECH.

BY NORMAN W. KINGSLEY, D.D.S.

It is not new, probably, to any of my hearers, that for the past eighteen years I have given much thought to correcting deformities of the oral cavity, and especially to the treatment of cleft palate.

During that period nearly every conceivable description of defective palates, both congenital and acquired, has come under my observation.

The only object I ever had in making appliances for congenital cleft has been to improve the speech.

The necessity of a knowledge of the mechanism of speech arose, thus, very early in my practice.

Without such knowledge, of a kind applicable to the education of patients who passed from my care, they might blunder along indefinitely in their efforts at improvement, with but little success.

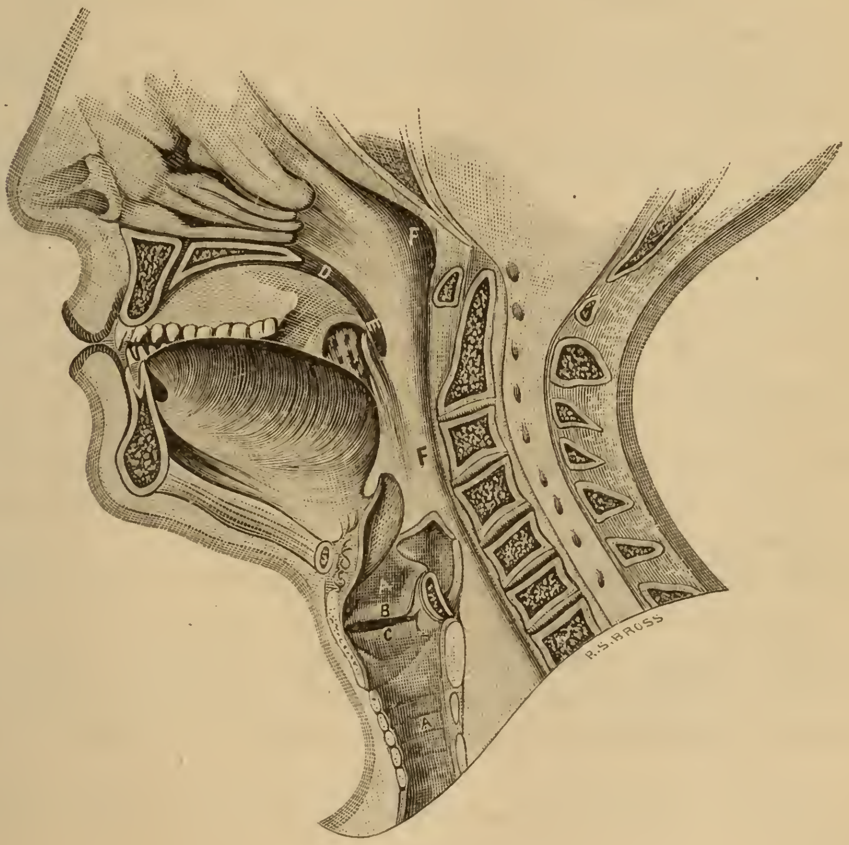

FIG. 1.

For the first few years I recommended such patients, after I had introduced the best appliance I could make, to employ some teacher of elocution to aid them. But the result was not altogether encouraging.

It was not elocution that these patients needed primarily to be taught—it was articulation; and it was rare to find any one sufficiently versed in the mechanism of speech to be able to teach articulation scientifically.

I was obliged in the end to undertake a course of observation, investigation and experiment, in order to make myself practically acquainted with the subject, so that I might supplement the services I had before rendered these people.

Such an investigation covered not only the philosophly of normal phonation and articulation, but I had constant opportunities of comparing the abnormal with the normal, and thus, perhaps, of obtaining in the end a more correct conception of the mechanism of normal articulation.

The present paper will be devoted to a description of the mechanism of speech where the functions are unimpaired; to be followed by some remarks upon articulation in cases of deformity, and the results of treating such cases with appliances.

Articulate speech is the result of vocal sounds, single or combined, continuous or interrupted, varied by pitch, volume and intensity.

An understanding of the mechanism of speech necessitates a knowledge of the physiology of the voice, and also some knowledge of the physics of sound.

All sounds, whether harmonious or discordant, are caused by the vibrations of matter.

Wherever there is sound there is motion. Musical sounds, and noises, are equally the result of vibrations.

The vibrations which cause musical sound are periodic, occurring at regular intervals, while the vibrations of noises are irregular, confused, non-periodic.

Sound may arise from the most diverse substances. A block of granite or a current of air may be set in motion and emit sound.

A current of air striking against a body of air at rest, may force it to vibrate rapidly and audibly.

Sound is always an evidence of motion, but motion can exist without sound appreciable to our ears.

Sounding vibrations must be at least 16 to the second. The lowest note of the double bass in an orchestra has 40¼ vibrations to the second, while occasionally an organ pipe is introduced the note of which has but 16 to the second.

The lowest C in a piano of 7 octaves has 32 vibrations, and the highest C, 4,096.

At 10,000 vibrations sound becomes piercing and painful, and loses its musical character.

At 32,000 to 40,000, the ear fails to take cognizance of the successive shocks.

The same number of vibrations always produces a sound of the same pitch, without reference to substance or cause of motion; the duration, intensity and quality may differ, but the pitch, with the same number of vibrations, is invariably the same.

The intensity, strength or loudness of sound is due to the amplitude of vibrations, or the distance the vibrating body traverses, and the length of time the vibrations continue.

No sound produced by the voice, or by a musical instrument, and heard with the ear as a single sound, is a simple sound; it is always a compound or composite one, made up of a number of tones of different intensity and pitch, together with a possible admixture of noises, all of which combined constitute a *clang*, and are heard as one sound.

For example, if a string drawn to the proper tension to emit a sound be plucked, it will not vibrate throughout the entire length as one vibration, but will be divided and subdivided into vibrating segments of varying lengths, each of which will emit a different tone. The longest segment, producing the most ample vibration, gives the loudest tone, and also the pitch to the clang, and its sound is called the fundamental tone. The other tones, made by the shorter segments, mix with the fundamental tone, the higher in pitch being the overtones, and the lower in pitch the undertones; and the whole constitutes the clang, which is heard as one sound.

The quality or timbre of musical sounds depends upon, and is governed by, this combination of harmonious tones and possible discordant noises accessory to the fundamental tone.

The medium through which sonorous vibrations are generally received by the ear being the air, we find such vibrations affected by the substances they come in contact with.

Soft substances will absorb sound, while hard ones, on the contrary, will reflect sound.

A room hung with massive drapery will muffle and absorb sound, while one with polished walls will reflect and echo it.

Sound may not only be absorbed and reflected; but its most interesting phenomena, as connected with our subject, is its augmentation or reinforcement by secondary causes.

A sound emitted by one body may cause another sounding body, capable of the same number of vibrations, to become sonorous by vibration, and the sound will then be repeated, augmented, prolonged; but the two sounding bodies must be attuned in unison.

For example, a musical sound made near the strings of a piano will cause the string in unison with it to vibrate and emit the same sound, which may be continued even after the first has ceased.

A glass tube closed at one end, containing a column of air of a certain length, can be made to resound by bringing its open end near a sounding body. The sound emitted throws the column of air within the tube into motion, and these vibrations are identical with those of the sounding body.

In this way the original note is augmented or reinforced; but there must be a correspondence of the column of air, to produce the result. If the column of air in the resonating tube is not in correspondence or unison with the sound emitted, there will be no response or augmentation. But if there be in the clang a single tone in unison with the resonator, that one tone will be reinforced to the exclusion of the others;

and if this augmented tone be not the fundamental tone, but one of the accessory tones--one of the overtones or undertones—then will the timbre of the whole clang be changed by the resonator.

A tube, or resonating cavity of incorrect internal dimensions would not respond to the same tone. The shape of such hollow bodies may be various. The material of which they are constituted is not important. Wood, glass, metal, rubber or putty can be formed into a resonating cavity. Resonance depends more on the form and dimensions of the cavity than upon the substance of its walls.

The recognition of this phenomenon has an important bearing on the mechanism of speech.

The reinforcement of tone by a resonating cavity in correspondence with the tone, is the key to the mystery of human speech.

Man speaks with his voice, and voice is simply sound caused by vibrations, and subject to all the laws which govern sound arising from any other source.

The apparatus which produces voice is both simple and complex—simple in its action, but complicated in its structure, and still more complicated and wonderful in its results. The power, the compass and the richness of tone, combined, of the human voice, are unapproached by strains from any other instrument.

Voice is intimately connected with one of the vital functions of life. Every breath we breathe can, with slight effort, be made to utter a sound. The vocal apparatus depends upon the breathing apparatus for its action and its power.

The same current of air driven from the lungs in natural respiration will produce sound by the slightest alteration in the form of the air passages.

"The principal organ concerned in the production of the voice is the larynx (See Fig. 1, A A.). The accessory organs are the lungs, trachea and expiratory muscles, and the mouth and resonant cavities about the face.

"The lungs furnish the air by which the vocal chords are thrown into vibration, and the mechanism of this action is merely a modification of the process of expiration. By the action of the expiratory muscles the intensity of vocal sounds is regulated.

"The trachea not only conducts the air to the larynx, but, by certain variations in its length and calibre, it may assist in modifying the pitch of the voice. Most of the variations in the tone and quality, however, are affected by the action of the larynx itself, and of the parts situated above it.

"It is impossible to give a complete account of the structure of the larynx, without going more fully than is desirable into purely anatomical details. We propose here only to refer to the situation of the vocal chords, and to indicate the modifications which they can be made to undergo, in their relations and tension, by the action of certain muscles.

"The vocal chords are stretched across the superior opening of the larynx from before backward (Fig. 1, B and C). They consist of two pairs. The superior (B)—called the false vocal chords—are not concerned in the production of the voice. They are less prominent than the inferior chords (C), although they have nearly the same direction. They are covered by an excessively thin mucous membrane, which is closely adherent to the subjacent tissue. The chords themselves are composed of fibres of the white inelastic variety, mixed with a few elastic fibres.

"The true vocal chords (C) are situated just below the superior chords. Their anterior attachments are near together at the middle of the thyroid cartilage, and are immovable. Posteriorly they are attached to the movable arytenoid cartilages; and, by the action of certain muscles, their tension may be modified, and the chink of the glottis may be opened or closed. These ligaments are much larger than the false vocal chords, and they contain a very great number of elastic fibres. Like the superior ligaments, they are covered with an excessively thin and closely adherent mucous membrane.

"Anatomists usually divide the muscles of the larynx into extrinsic and intrinsic. The extrinsic muscles are attached to the outer surface of the larynx and to adjacent organs, such as the hyoid bone and the sternum. They are concerned chiefly in the movements of elevation and depression of the larynx. The intrinsic muscles are attached to the different parts of the larynx itself, and, by their action upon the articulating cartilages, are capable of modifying the condition of the vocal chords.

"During ordinary expiration none of the intrinsic muscles seem to act, and the larnyx is entirely passive, while the air is gently forced out by the elasticity of the lungs and of the thoracic walls. But as soon as an effort is made to produce a vocal sound, the appearance of the glottis undergoes a remarkable change, and it becomes modified in the most varied and interesting manner, with the different changes in pitch and intensity which the voice can be made to assume. Although it is sufficiently evident that a sound may be produced, and even that words may be articulated, with the act of inspiration, true and normal phonation is effected during expiration only."*

The trachea conducts the air from the lungs to the larynx, and reinforces the sound to some extent by vibrations of the column of air in its interior. The trachea can be elongated and shortened at will. It is shortened and its calibre increased in the production of low notes, and elongated and contracted in the higher ones.

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* Flint.

The larynx also varies in capacity in the same individual, both its length and breadth being diminished in high notes and increased in low ones.

"The most important modifications of the laryngeal sounds are produced by the resonance of air in the pharynx, mouth and nasal fossæ.

"This resonance is indispensable to the production of the natural human voice. Under ordinary conditions, in the production of low notes, the velum palati is fixed by the action of its muscular fibres, so that there is a reverberation in the bucco-pharyngeal and naso-pharyngeal cavities; that is, the velum is in such a position, that neither the opening into the nose nor into the mouth is closed, and all of the cavities resound (D, Fig. 1.).

"As the notes are raised, the isthmus contracts, the parts immediately above the glottis are also constricted, the resonant cavity of the pharynx and mouth is reduced in size, until finally, in the highest notes of the chest register, the communication between the pharynx and the nasal fossæ is closed, and the sound is reinforced entirely by the pharynx and mouth.

"At the same time the tongue, a very important organ to singers, particularly in the production of high notes, is drawn back into the mouth.

"The point being curved downward, its base projects upward posteriorly and assists in diminishing the capacity of the cavity.

"In the changes which the pharynx thus undergoes in the production of different notes, the uvula (E) acts with the velum, and assists in the closure of the different openings. In singing up the scale, this is the mechanism, as far as the chest-notes extend. When, however, we pass into what is known as the head-voice, the velum palati is drawn forward instead of backward, and the resonance takes place chiefly in the naso-pharyngeal cavity." *

Difference of pitch in voices is due chiefly to the greater length of the vocal chords in low pitched voices, and to their shortness in higher ones.

The same note sung by a male voice and a female voice shows a difference of an octave, owing to the difference in the number of vibrations.

In the low chest tones the vocal chords are elongated, and at the minimum of tension that will allow of regular vibration.

Differences in quality are due to peculiarities in the conformation of the larynx, and to variations in the size and form of the auxiliary resonant cavities.

Many of the different qualities of the human voice are due to the difference in the length, breadth and thickness of the vibrating ribbons.

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*Flint.

Voice is produced first, and to a limited extent, by the vibration of the column of air in the larynx during the act of expiration; secondly, and principally, by vibrations of the vocal chords; and thirdly, by resonance in the buccal and nasal cavities.

The accessory organs, in producing modifications of the voice, are the pharynx, the velum palati, the tongue, teeth and lips.

The pharynx (F F, Fig. 1) may be likened to a muscular tube or bag, open and continuous below with the æsophagus, open and continuous above with the nasal passages, and open also in front to the buccal cavity. Its walls are muscular, and capable of powerful contraction, even to complete closure of the passage.

The pharynx executes an important office as an organ of speech—passively as a resonating cavity, and actively by the movements of its constrictor muscles.

By them the upper portion of the pharynx is contracted, and its posterior wall advanced until it meets the palate, and thus throws the voice forward into the buccal cavity. This action of the pharynx can be studied with ease in cases of cleft palate.

Movements which are hidden in a normal condition are then fully exposed to view. I have observed many cases where, in the effort to produce certain sounds, the superior constrictor would develop a ridge or roll of considerable magnitude horizontally across the pharynx. This pharyngeal movement, important in normal articulation, becomes an essential requisite to success when articulation with an artificial palate is attempted. In a normal condition, the posterior nasal passages are closed by the continued action of the palate and the constricted pharyngeal wall. In an abnormal condition of absence of the palate, the pharyngeal action may be made to perform the office of both.

The velum palati or soft palate is a muscular curtain, attached to the posterior edge of the bony roof of the mouth or hard palate, and hangs down as a partition between the buccal and nasal cavities, forming the double-arched boundary to the fauces, with the pendulous uvula dropping like a tassel from its centre margin (Fig. 1, D E.).

It is composed entirely of muscular tissue, and is overlaid with mucous membrane. It moves like a valve between the buccal and nasal cavities—now against the pharynx, directing the outward current through the mouth, now against the dorsum of the tongue, directing the current through the nose, and again hanging between the extremes, dividing the current and column of sound, and permitting it to pass through both channels.

So much attention has been directed to this organ within the last few years that it seems almost superfluous to refer to the disastrous results to articulation which follow its loss. It is only necessary to bear in mind that more than three-fourths of the sounds of articulate language depend upon the integrity of the palate for their perfect enunciation.

The tongue is generally regarded as the most important organ of speech; but it is said that there are numerous instances where the tongue has been lost by accident or design, and the sufferers continued to articulate as before. However this may be, I know only that in all cases which I have ever seen of destruction of the palate, articulation was very much impaired, and in some cases entirely destroyed. In variety of movement, the tongue plays the most important part in altering the resonating capacity of the buccal tube or cavity. The teeth, as organs of articulation, have not received the attention from dentists that their importance demands. They have been regarded by them almost universally as organs of mastication merely; and when artificial ones were required, if the masticating ability was secured without seriously interfering with the looks, both dentist and patient were satisfied. The neglect to recognize them as important organs of speech has arisen, partly from the general ignorance in reference to the mechanism of speech, and partly because neither the entire loss of the natural teeth, or the substitution of very inferior artificial ones, has actually destroyed articulation; nevertheless the dentist may interfere very seriously with the comfort of both a speaker and listener, by a badly arranged artificial denture.

The only remaining organs to which I direct your attention in this system for the production of speech, are the cheeks and lips, nares and nostrils; but their physiological action is not such as to require here an extended notice, further than to say that any considerable departure from a normal condition, through deformity or disease, will impair their functions.

Morbid growths in the nares, destruction of the turbinated bones or the vomer, a fissured lip, or an enlarged nostril, commonly associated with a harelip, are all abnormal conditions affecting articulation.

Having thus made ourselves familiar with the physics of sound, and the physiology of the voice, it remains to describe how voice becomes speech.

Articulate language is an aggregation of definite sounds associated with definite ideas, which, in the progress of time, has grown to be so complex a system, that nearly every idea of the most subtle brain can be conveyed to another mind by sound alone; and by habit we come to regard the idea and the sound which expresses it as almost identical. So perfect a system of articulate language must be possessed by man alone; nevertheless we cannot deny that other animals of the creation, possessed of vocal organs similar to man, and capable, also, of much variety of voice, may have an articulate language of a limited range.

The proofs are not wanting in every-day life of animals who understand our speech and execute our commands from our voice alone, showing that they appreciate sound, and that it conveys to their apprehension our ideas.

It is not unreasonable to suppose that they, too, have an articulate language quite sufficient to communicate to each other all their ideas.

A remarkable illustration of how naturally a human being resorts to sounds to express its wants, without adopting the conventional form, occurred in my own family.

A little daughter of mine had a nurse in infancy who was very musical, and was constantly singing or humming little strains of music. The child caught them up, and associated certain notes or strains with its own wants and ideas. Until she was nearly three years of age she rarely articulated a word beyond *papa* and *mamma*. I began to fear she never would speak. During this period all her wants were made known by harmonious strains, which we came to understand as readily as if it were our own vernacular. It was astonishing to observe to what extent and perfection this musical language of a child could be carried.

With such an elaborate system as the speech of civilized nations has now become, expressing, by sound, the nicest shades and distinctions of thought, we might expect to find the mechanism of speech so complicated as to be beyond our comprehension; but the investigations of scientists within the last few years, particularly since the production of the laryngoscope, have cleared up and exposed the nature of vowel sounds, which was incomprehensible for ages.

Voice is caused by the action of the expiratory muscles driving the breath outward through the larynx. The sound produced by the vocal chords is not a simple sound, but a clang, as we have seen in our sketch of the physics of sound. The mouth can be held in different positions, the tongue, palate and other organs may be so placed as to give great variety, in form and dimensions, to the buccal cavity; but, whatever shape it assumes, it must have, like all other hollow bodies filled with air, like all other resonators, its own tone-character, in each different form and dimension. Consequently we find that as the sound or clang passes out through the mouth, some one tone of the clang, which corresponds with the tone-character of the buccal cavity at that moment, will be augmented and itensified. This reinforcement by resonance changes the timbre of the laryngeal clang, and, in the words of Prof. Elsberg, "in this changed timbre consists the nature of vowel sounds. A vowel is the timbre which results from the increase, by resonance, of one or more tones in the laryngeal clang."

Pure vowel sounds can be made only by resonance of the buccal cavity, alone, and in its normal integrity. Let any other cavity communicate with it and its tone-character is destroyed, and, consequently, the purity of its vowel sounds. Make a communication with the nasal cavity, either great or small, and pure vowel sounds are impossible. Lift out the cheeks, as is sometimes done with improperly adapted plumpers, and there are created new resonating cavities, which destroy the tone-character of the buccal cavity.

I have known all the purity, delicacy and sweetness of a woman's voice destroyed by a dentist, in building plumpers upon an artificial denture to fill out the cheeks.

The power to change the form and dimensions of the buccal cavity is very great, and equally great is its power to change the laryngeal clang.

This change of timbre in the clang may be continuous and uninterrupted from one extreme to the other; and what are called the different vowel sounds are but the points along this vocal stream, which our ears separate and distinctly mark one from another.

Articulate language may adopt as many divisions of this vocal stream as the ear can distinguish; but practically it is not desirable to burden a language with extremely nice shades of sound.

Fewer and more decidedly marked notes, or variations, are preferable.

The five most distinctly marked vowel sounds used in the English language are—oo, o, ah, a, e.

In the production of these vowels, according to Tyndall, the laryngeal clang undergoes the following changes:

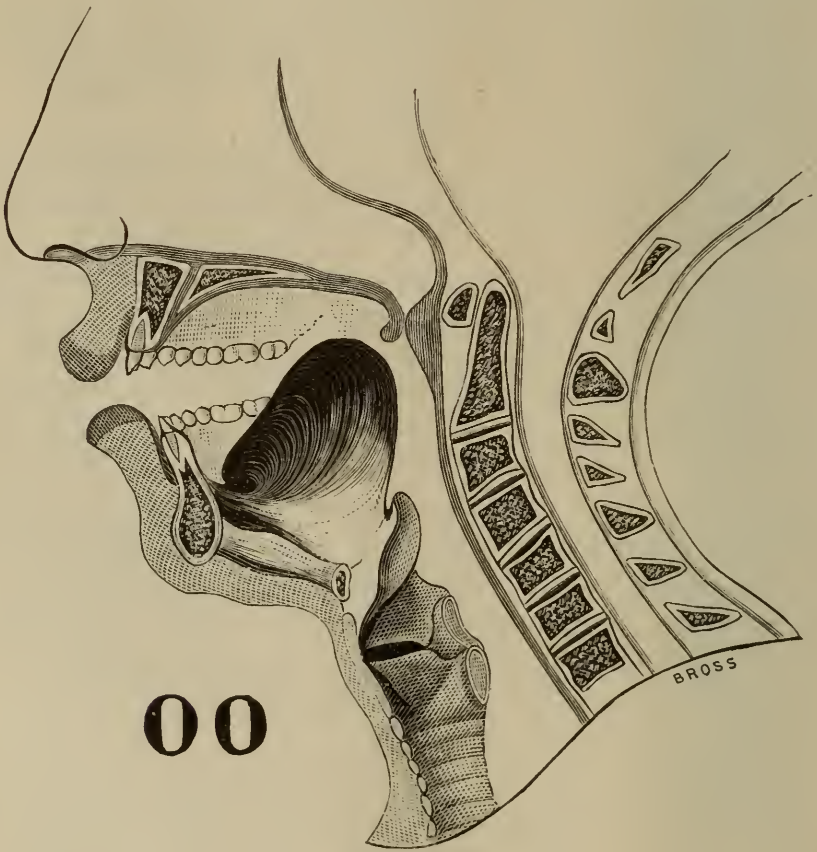

Fig. 2.

"For the production of the sound U (oo, in hoop), I must push my lips forward, so as to make the cavity of the mouth as deep as possible, at the same time making the orifice of the mouth small. This arrangement corresponds to the deepest resonance of which the mouth is capable. The fundamental tone of the vocal chords is here reinforced, while the higher tones are thrown into the shade (See Fig. 2.).

"The vowel O is pronounced when the mouth is so far opened that the fundamental tone is accompanied by its strong higher octave (See Fig. 3.).

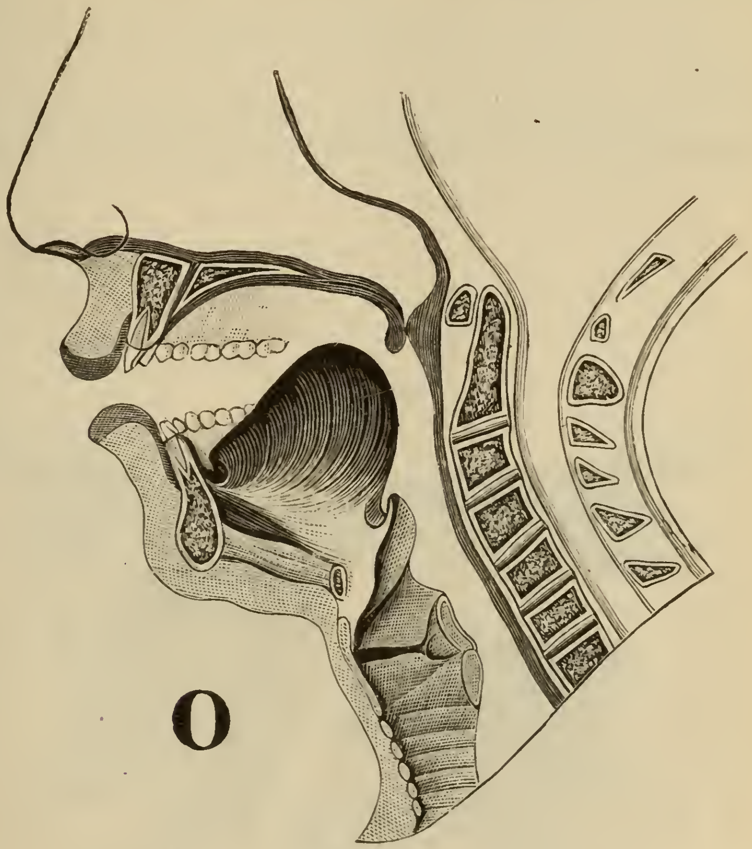

Fig. 3.

"In the production of the sound AH, the higher overtones come principally into play. The second tone may be entirely neglected; the third rendered feebly; the higher tones, particularly the fifth and seventh, being added strongly (See Fig. 4.).

"The vowel A derives its character from the third tone, to strengthen which, by resonance, the orifice of the mouth must be wider, and the volume of air within it smaller, than in the production of O. The second tone ought to be added in moderate strength, whilst weak fourth and fifth tones may also be included with advantage (See Fig. 5.).

"To produce E, the fundamental tone must be weak, the second tone comparatively strong, the third very feeble; but the fourth, which is characteristic of this vowel, must be intense. In order to exalt the higher tones which characterize the vowel sound E, the resonant cavity of the mouth must be small" (See Fig. 6.).

Between these five principal sounds there may be numerous shades of sound, owing to the variety of forms which the buccal cavity can be made to assume. For example, the sound of AU, which comes between AH and O; also the sound of UH, which by some has been called the natural vowel, because in its formation all the organs seem to be in the most easy, natural and unrestrained position. Each of the five sounds represented as separate and distinct sounds may be made to insensibly glide into the others, and form one continuous sound varied only in timbre and in pitch.

It will be observed in each of the diagrams representing the position of the organs in the production of the vowel sounds, that the soft palate is elevated, the pharyngeal wall bulges forward, and the uvula doubles against it.

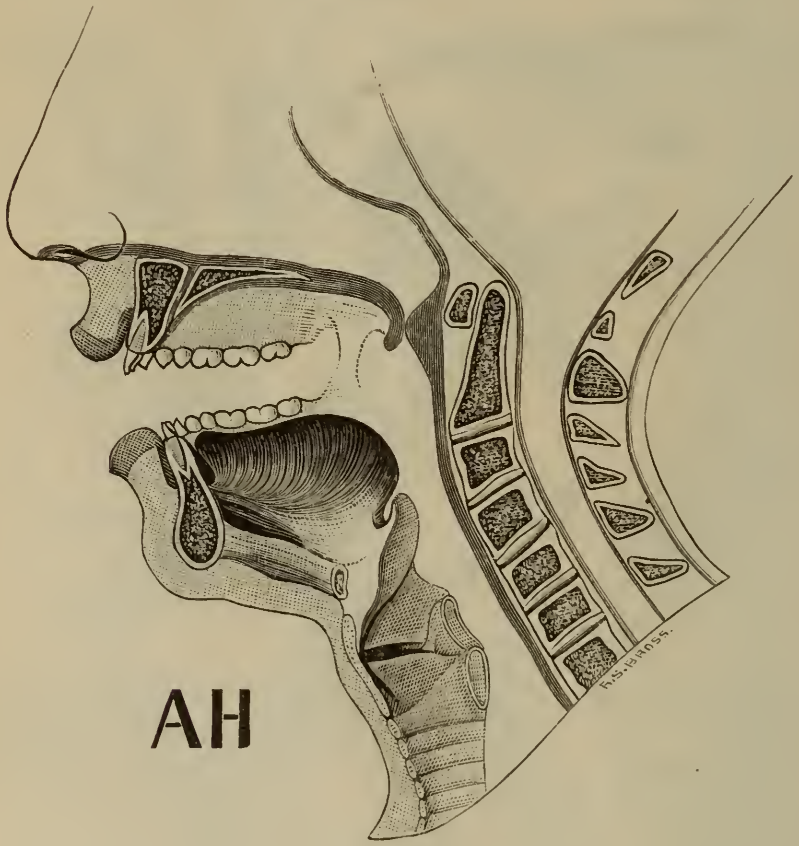

FIG. 4.

These drawings, and those which follow, were all made by myself from studies of the organs in action in many cases, and are the record of observations of one mouth with well-developed organs.

The separations of the jaws and lips were determined accurately by measurement, the varying positions of other organs by repeated observation and other tests, and all drawn to a uniform scale and here reduced. They are, therefore, consistent with each other. But it must be borne in mind, that even if it were possible to obtain absolutely accurate models of the organs of speech, while in action, of any number of cases, it is not probable that any two of them would be exactly alike.

It is not supposable that all persons, in making the same sound, place the active accessory organs—the tongue, palate, etc.—in the same identical position.

Variations, to a greater or less extent, can be observed in every one. Exactly the same resonating cavity in form is not likely to exist in any two persons, any more than we find any two jaws exactly the same.

With the fixed portion of any buccal cavity differing somewhat in form from every other, the changeable portions, such as the tongue and palate, adapt themselves to the circumstances, and produce a resonating cavity of the same tone-character.

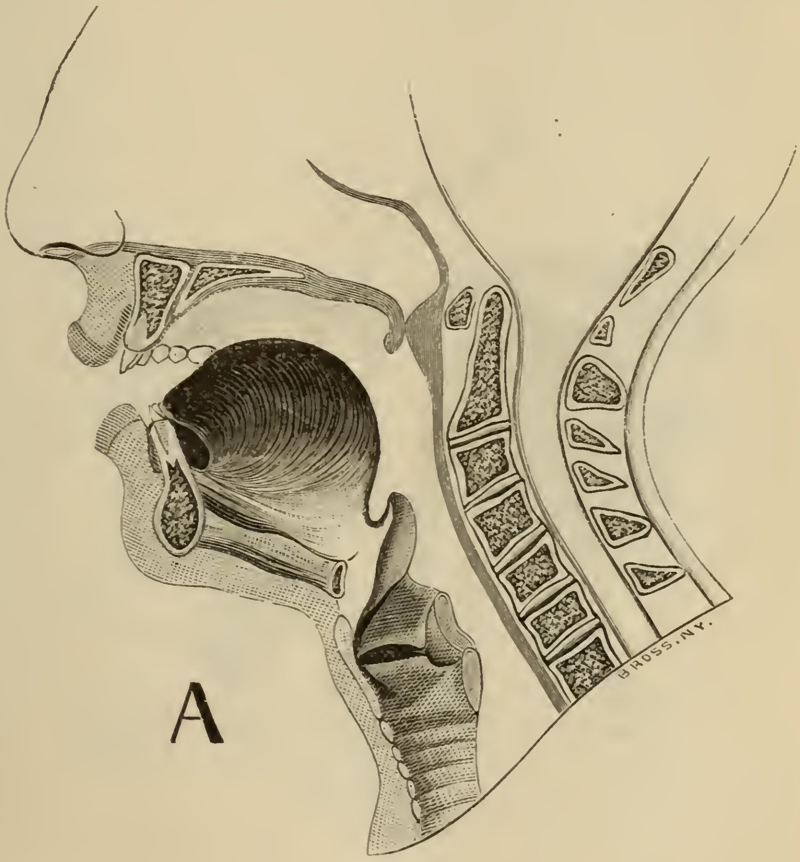

FIG. 5.

So long as the integrity of the accessory organs is preserved, a resonating cavity of like tone-character can be formed.

The limits of this paper will not permit an analysis or explanation of all the sounds that combine to form articulate language; our efforts must be confined to the language in which this paper is written. Nor may I be able even to give such an explanation of the formation of every consonantal sound of the English language as would satisfy the most critical observer. Nevertheless, the action of the organs accessory to the vocal organs in the mechanism of speech has been so closely studied, that there would be but little diversity of opinion in regard to most of them.

Articulate speech is made up of vowel and other sounds—pure, interrupted or checked.

The pure vowel sound we have already sufficiently considered. The interrupted or checked come under the general term of consonants, and are divided into various classes—such as labial, dental, palatal, nasal—each term bearing some relation to the locality in which the formative action takes place.

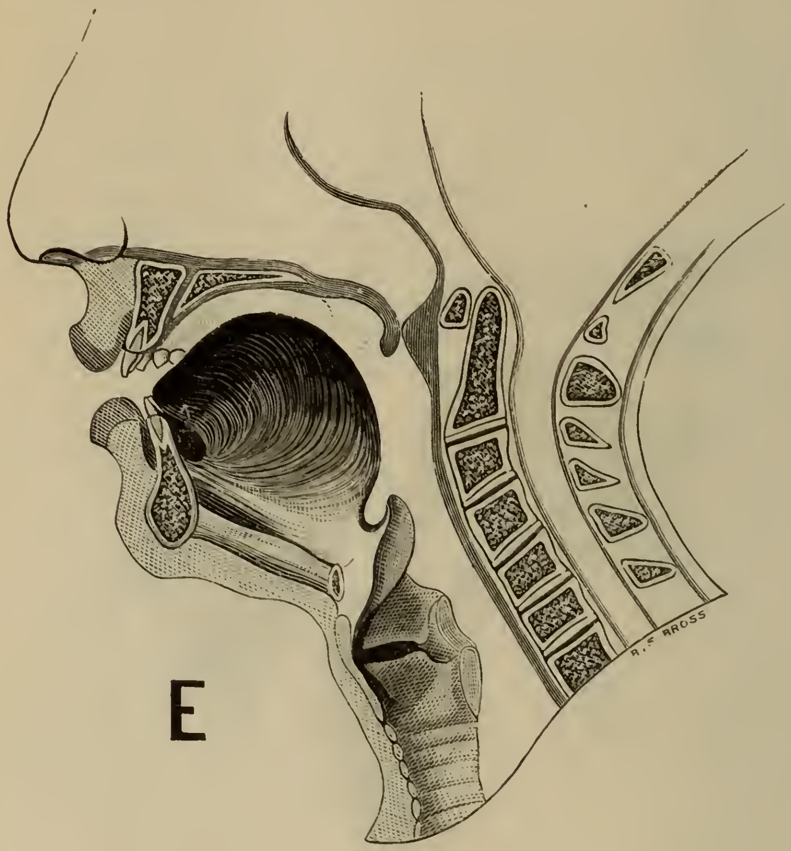

Fig. 6.

There are various other divisions and subdivisions of consonants, making distinctions of great interest to the physiologist and the linguist, but which are also beyond the scope of this paper.

I know of no better way to make a description appreciated by my audience, than by beginning with the simplest articulate sound of childhood.

Have you never considered that the terms we applied to our parents in childhood were the names the easiest and most natural for infancy to pronounce? What is papa but the sound of P joined to the vowel AH? We have already described the vowel sound, and to produce the sound of P we have only to stop the sound of AH by closing the lips.

Observe that in making the sound of AH, all the principal as well as the accessory organs are in their most easy, natural and unrestrained position. The sound of AH is but the natural voice of the child flowing out of the mouth, when it is stopped by closing the lips and suddenly opening them, and the sound of P is the result. It makes no difference whether the movement of the lips follows or precedes the emission of sound; the P lies in the act of closing and opening the lips, joined to a vocal sound. Repeat this shutting of the lips upon the sound of AH with sufficient rapidity, and we have *papa*, the simplest and easiest word in the English language that a child can utter.

Let us take another illustration from the same source—mamma. The action in the formation of the sound of M is identical with that of P, up to a certain point. The vocal sound passes the mouth in the same manner, and in the same way the lips are closed upon it; but instead of the lips being suddenly opened to allow the escape of accumulated breath, they are held closed, and the vocal sound continued; but finding escape no longer by the mouth, it passes out by way of the nose.

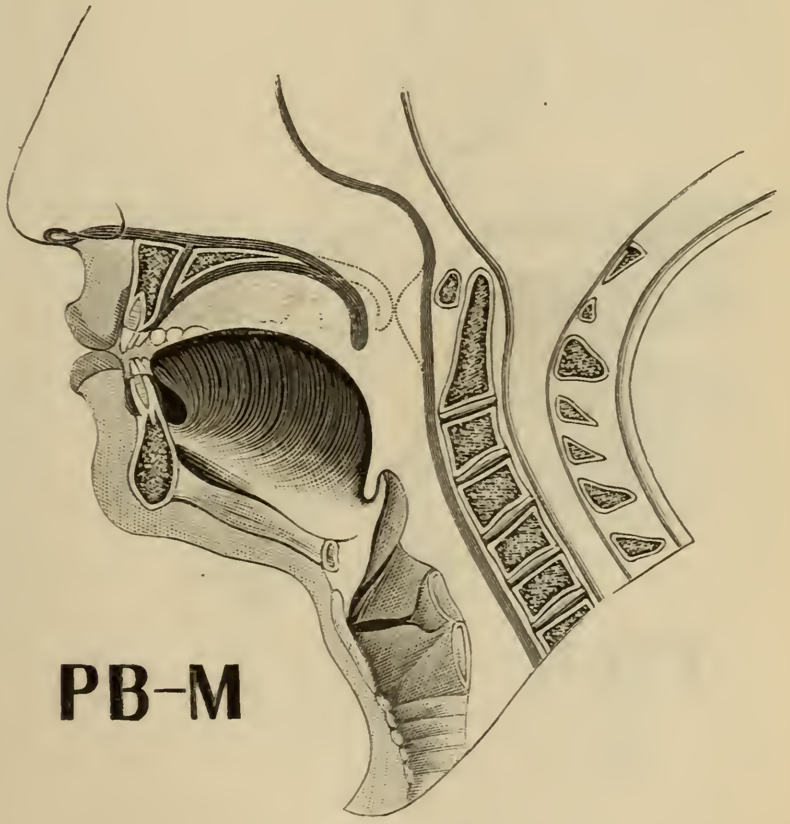

FIG. 7.

This prolongation of the nasal sound through the nares—this nasal termination of the vowel in forming M, as against the stoppage of sound by the lips in P—is all that distinguishes the two sounds. M, therefore, is P made nasal by prolongation. Physiologically, the difference lies solely in the position of the palate (See Fig. 7.). With P the palate is in contact with the pharynx, and shuts off the nasal passage. With M the palate droops, and leaves an escape for the sound.

Akin to M and P is the sound of B. Its formation is identical with that of P until the lips are closed.

The distinctive characteristic of B is, that after the lips are closed the sound is not stopped, but continued in the buccal cavity. This necessitates the closing of the nasal passage by the palate, the same as in forming P.

If the nares were opened, the continued sound would result in M; but being closed, the sound can fill only the buccal cavity, and B is the result; and, like M and P, it matters not whether this action precedes or follows the vocal sound, nor is it important that the sound in the buccal cavity be prolonged—but *it is* essential that the sound should be momentarily heard in the confined buccal cavity.

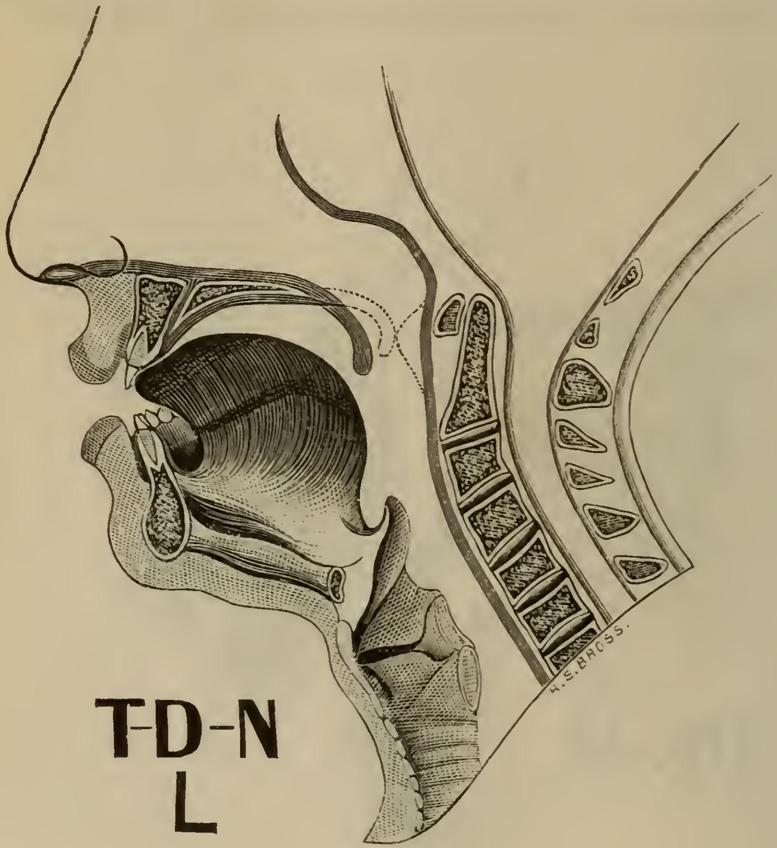

FIG. 8.

These three sounds are called labials, because the lips are principally concerned in their formation.

In Fig. 7 is shown the position of the organs in the formation of the three labials; with P and B the pharyngeal wall is advanced and the palate elevated; with M the palate droops and the pharynx relaxes.

We will consider now a second class of consonant sounds, called dental, and will take up another word from the child's vocabulary—ta-ta. This sound is as simple as papa, and its only difference is, that in papa the lips stop the emission of sound, while in ta-ta the vocal sound, or vowel AH, is stopped by placing the end of the tongue upon the gum immediately behind the front teeth; and the only physiological difference between P and T is, that the vowel is stopped by the lips in the first, and by the end of the tongue in the second. In all other respects they are equal (Compare Figs. 7 and 8).

Make the vowel sound AH and interrupt it rapidly with the tongue as described, and we have the continued sound of *ta-ta*. Again, place the tongue in the same position, and allow the sound, after closure, to be continued through the nasal passages, and we get N. In exactly the same way in which we saw that P was turned into M, do we find T turned into N.

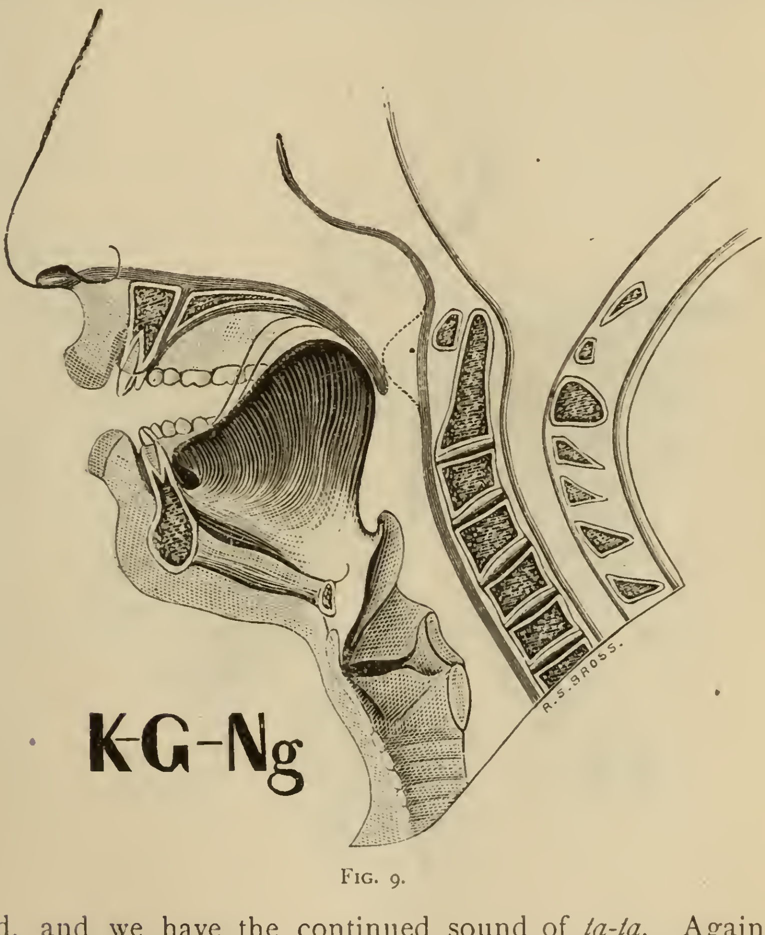

FIG. 9.

Again, make a vowel sound, and check it with the tongue as before, but, instead of letting it escape by way of the nose, let it well up into the buccal cavity, and you have formed D.

In the same way that B was made from P, is D made from T.

Take, now, another sound as nearly related to D as we found T to be—

i. e., L. To illustrate its formation, make the sound of D with the vowel before it, as in *ad*. The termination of D we saw to be in the buccal cavity confined by the tongue against the upper gum in front and at the sides.

If, now, while the terminating sound of D is in the buccal cavity, the sides of the tongue are released, the tip of the tongue still held firmly in front, and the sound continued through the side escapes, L is formed. In Fig. 8 this relaxation of the sides of the tongue for the escape of L is shown by a lighter band across the tongue. During its production the palate and pharyngeal wall must be in contact.

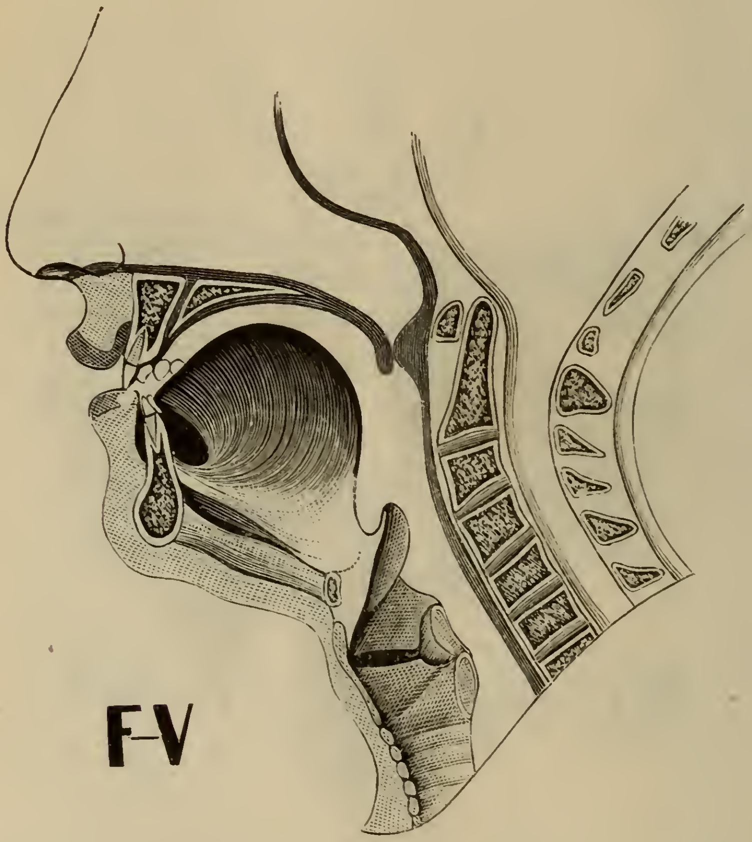

FIG. 10.

Physiologically, the sounds of L and D are so nearly alike, that we can say that D is confined in the mouth and L escapes at the sides of the tongue, all the organs being otherwise in the same position. L also receives some characteristic augmentation from the vibrations of the sides of the tongue, as the current passes. The near relationship of D and L is very readily observed by the ease with which they are both sounded in words where they come together, as in "handle."

We have thus two sets of sounds corresponding with each other in their methods of formation, save that one set is controlled by the lips and the other by the end of the tongue.

P corresponds with T, M with N, and B with D.

There are three distinctively marked points at which sound is checked or interrupted—the lips, alveolar ridge, and soft palate. Two of these we have noted. As P corresponds with T, B with D, and M with N, so shall we see that K, G and NG form another trio of sounds related to each other in much the same way; the check for this trio being at the back of the buccal cavity, and made by bringing the extreme back of the tongue against the soft palate in front of the uvula, thus closing the passage to the mouth, and by advancing at the same moment the upper part of the pharynx to meet the palate behind and stop egress by the nares.

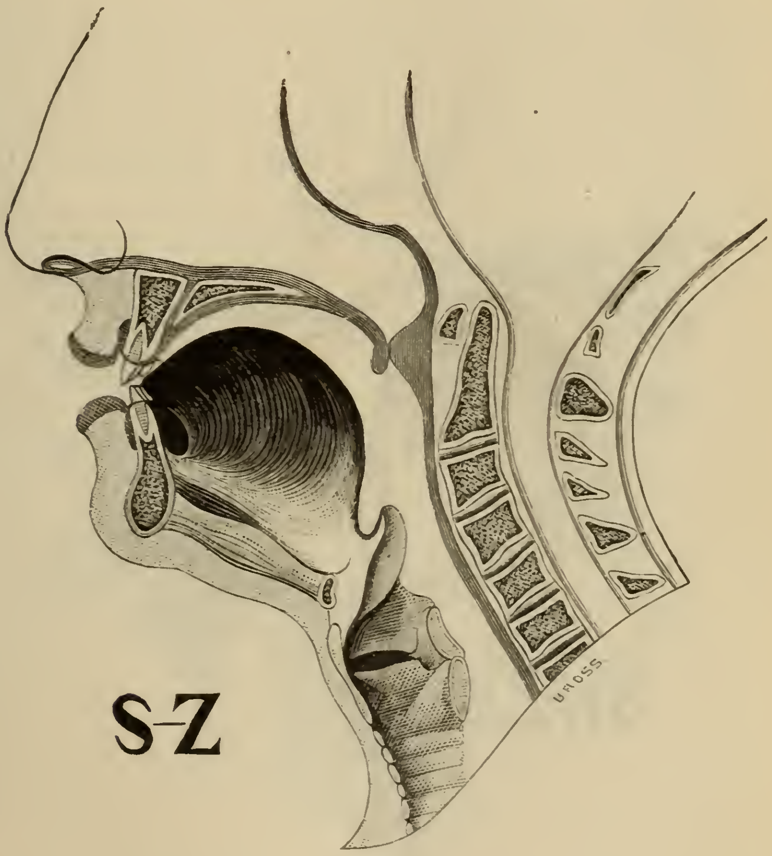

FIG. 11.

K is formed by the organs in that position, either suddenly beginning a vowel sound, or as suddenly checking it—as P was checked by the lips. G is the result of the sound continued momentarily, if the organs are closed; and NG is the prolongation of the sound through the nares, with the pharynx relaxed, and the tongue still held firm against the palate (See Fig. 9.).

Let us consider now another element besides vocal sound in articulate speech—breath sound, or a current of air driven through a chink. For example, make again a vowel sound, and check it by placing the edge of the lower lip against the edge of the upper front teeth, and continue the current of air, but not the vocal sound, through the teeth, or through a narrow aperture between the edge of the teeth and the lip.

This termination of a vowel sound by a breath sound in this manner forms F; or the reverse—beginning a vocal sound by a breath sound—produces the same result.

We can change F into V by vocalizing the breath sound; in other words, V is formed exactly like F, only that the current past the teeth is vocalized (See Fig. 10.).

Take another example of two sounds, the difference in which is that one is breath sound only, and the other vocalized breath. Place the tongue against the upper gum in the same way and position as when T is formed, leaving at the end or tip a narrow chink for escape. A current of air driven through this aperture will produce a hissing sound identical with the hiss of a goose. This is a breath sound, and in no sense a vocal one; but it is all there is of the sound of S; and independent of a vowel, to which it might be joined, it would be of no more value in our language than would be the cavity sounds of B or D without their vowel connections.

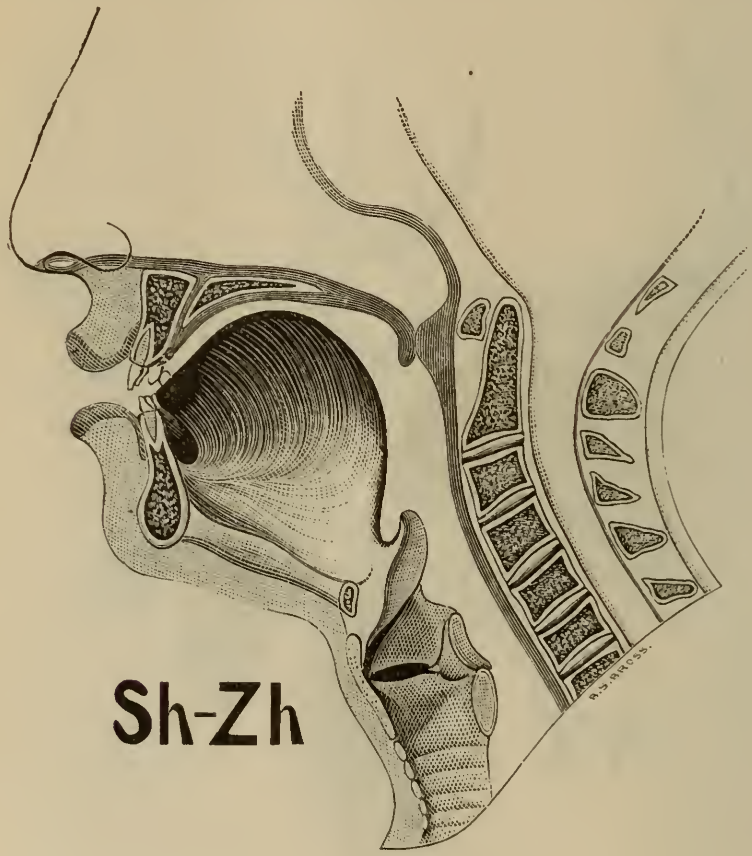

FIG. 12.

Its corresponding sound, Z, however, is a vocal sound, and is made with the tongue and other organs in exactly the same position; but the breath current is vocalized in one, and unvocalized in the other.

The formation of both depends upon the only outlet for the breath being the narrow chink at the tip of the tongue, and the sound is not affected by a closure of the teeth, so long as there is escape for the breath current (See Fig. 11.).

SH, as in *hush*, is a breath sound, made with the tongue placed in a similar position to S, the difference being that the aperture for the escape of S is immediately behind the front teeth, while in SH a similar aperture is wider and higher up, which seems to take away the sharp, hissing sound of S.

There is considerable latitude in making this sound, and its pitch may be varied considerably, without seeming to affect its importance.

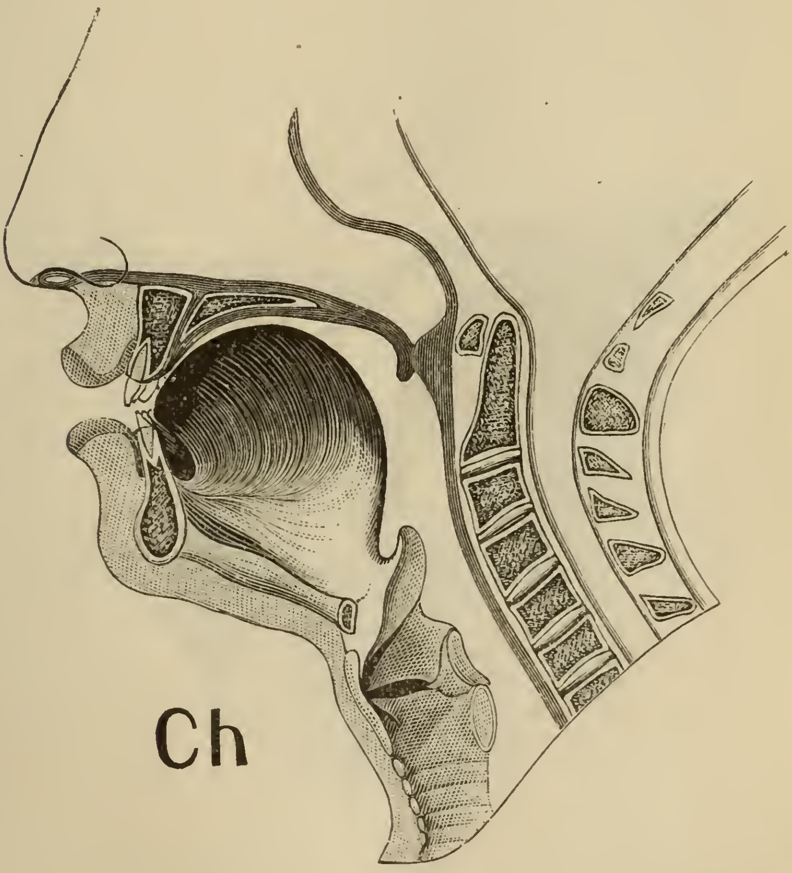

Fig. 13

For example, the lips may be held as in P, or they may be considerably protruded. The advanced position of the lips seems the easier and the most natural, but the result for the purposes of speech is essentially the same.

ZH holds the same relation to SH that Z does to S. ZH is the vocalized current which, unvocalized, forms SH (See Fig. 12.).

The sound of CH is closely allied to the last two, but is, when clearly enunciated, a distinct sound from any other. It is formed by bringing the forward part of the tongue in contact with the upper gum. The point of contact is not at the tip, as in T, but farther back on the tongue, and higher up on the gum (See Fig. 13.).

The two sounds of TH, as heard in *thin* and *thou*, are other examples of breath sound and vocal sound, with the tongue in the same position for both. The aperture for the escape of this sound is much the same as in SH, but the tongue is more advanced. There may be some latitude in the position of the tip of the tongue, without materially affecting the result.

The sound can be produced with the tongue projecting beyond the edges of the upper teeth or retracted entirely within the dental border (See Fig. 14.).

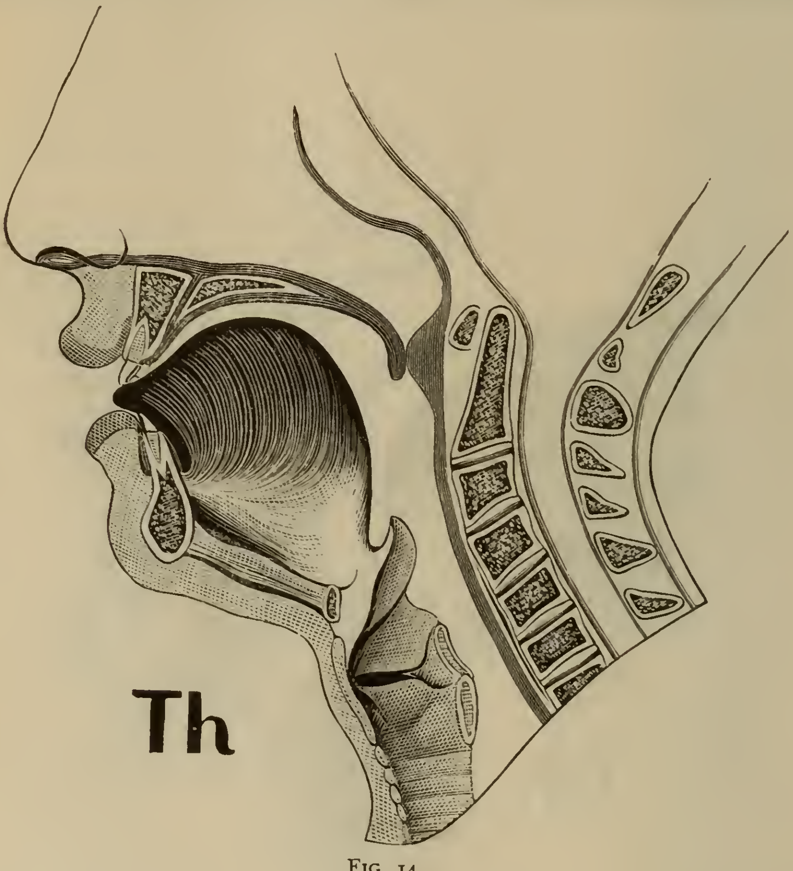

FIG. 14.

In Fig. 15 is shown the position of the tongue in making the sound of R. The buccal cavity at the time of the formation of this sound corresponds with that in the production of the vowel AH. In fact, many people sound R so slightly, that it is little if anything more than the vowel AH. But the formation of R requires that the tip of the tongue should be pointed upward, and vibrated while the vocal current is passing. With some the tip of the tongue is distinctly felt against the roof of the mouth during these vibrations; while with others it is below, as represented in Fig. 15. Neither does it seem requisite that the tongue should be pointed to the same locality in the roof—it may be farther forward or farther back. The sound of R is produced by the rapid interruption of the voice, in the above described manner, in the middle of the mouth.

In some languages this sound is much more marked and distinct than it is generally made in English. With some English-speaking people it is an affectation of refinement to banish it almost entirely.

The foregoing explanation comprises nearly all the distinct sounds which form the English language.

The sounds of the other letters of the alphabet, not here named, are either repetitions or combinations of those described, or are not so distinctive in their mechanism as to be illustrated by a separate diagram. For example, C is a repetition of K or S, as it is used either hard or soft.

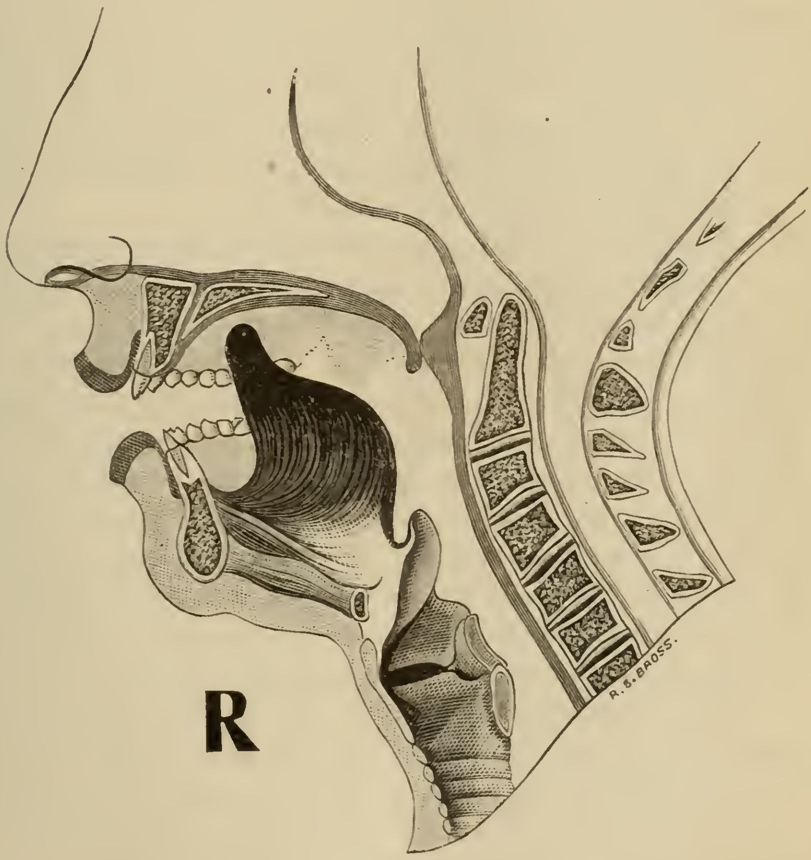

Fig. 15.

J is very nearly, if not exactly, a combination of DZH, and W is so nearly the vowel OO that a diagram cannot illustrate an appreciable variation.

The foregoing explanation presupposes that all the organs are duly developed and fulfilling their normal functions.

From the diagrams it will be seen that in the formation of all the vowel sounds the veil of the soft palate is carried upward, and hugs the advanced posterior wall of the pharynx. This seems to be essential to the formation of resonating cavities of uniform tone-character. Consequently, if the palate be destroyed or congenitally absent, a new resonating cavity is exposed, and the tone-character of the buccal cavity is changed. These sounds can no longer be made in the same way, and in many cases cannot be made in their purity at all.

DISCUSSION.

Dr. Louis Ellsberg (*New York*): I have listened with much interest to Dr. Kingsley's able paper, although I must take the liberty to differ with him on some points of minor importance. You perceive that he has made the *vallecula*, or little valley between the base of the tongue and the epiglottis, of about the same size and shape in all his diagrams, no matter what sounds are represented. As a matter of fact, while it is open in the sound *e*, it is closed by the tongue in the sounds *oo*, *o*, and *ah*. For this reason it is impossible to get a view of the parts of the larynx unless when *e* or *a* are pronounced. Again, the sound of *h* is not simple, but is compounded of *t* and *sh*.

Dr. Kingsley told you that the differences between sounds are due solely to changes in the *timbre* or tone produced. Lest this may not convey a clear idea to your minds, I will refer to the discovery of Helmholtz, that no sound of the voice is simple; but that all voice sounds are compound and complex. In illustration, let me refer to any chemical compound. To our eye it appears simple, but we know that it is composed, in reality, of many elementary bodies, by the different arrangement of which we get resulting compounds of different appearance and quality. Just so is sound made up of various elements, the varying arrangement of which produces variations in the resulting sound; and these variations constitute *timbre*, or tone. As the resonator is approached to or removed from this bell, you hear the sound louder or more indistinctly; and so the sound produced in the lower vocal organs is changed, in its *timbre*, its composition, and its quality, by its passage through the succeeding differently constituted resonant parts. Tone is really the same in its fundamental parts in all the sounds. The G of the violin, the flute, the piano and the voice is the same in its basal form in all these instruments; but you readily recognize a certain difference between them. This difference is caused by the *overtones* which accompany the G in each case being different, and thus giving a different *timbre* for each instrument.

The sounds of the voice are found to be in the character of a musical scale. In pronouncing *oo*, *o*, *a*, *ah*, *e*, you will perceive that a kind of ascending scale of sound is formed, which you can render descending by reversing the order of pronunciation. This change in tone is produced by the variations in the vocal cavity of the mouth, the cavity being least in *oo*, and greatest in *e*. This scale, or any one note, is made loud or soft according as more or less air is used in its pronunciation. This holds good, also, with the consonants. For instance, *p*, *k*, *t*, *f*, *sh*, *iss*, form an ascending scale from *p*. The reason of the difference of tone in the same sound as produced by a man and a child, is found in the fact that the relation of the orifice of the mouth to the oral cavity changes the tone; thus a child, possessing only a small mouth cavity, can yet produce the same resonating pitch as a man by simply closing the opening more.

There are minor points in Dr. Kingsley's discourse upon which, doubtless, he and I could argue for a long time; but he has presented the general truths of the subject so well, that I counsel you to study that presentation carefully; for the subject is unquestionably of great importance to all who practice the introduction of apparatuses in the oral cavity.

STEPHEN PEARL ANDREWS (*New York*): I am not a dentist; but the subject of the voice in its various scientific aspects is one to which I have given much attention. My relations to the matter have grown out of the introduction in this country (made by me, about thirty years ago,) of the science of phonetics, upon which is based the science of phonography. But I have carried the subject much farther than this, and have studied carefully the whole range of sounds producible by the human voice in all languages. Such investigation reveals the fact that, as far as sound is concerned, there is really but one alphabet in the world. The number 64 will represent all the sounds the human voice is capable of producing. Our text-books are very deficient in their presentation of this subject; for, while they tell us there are vowel sounds and consonant sounds, they give no information as to the character of the difference between these. Another point to be remembered is, that when we talk of sounds we do not necessarily refer in any way to letters, since the latter are merely the arbitrary written representatives of certain of the sounds which we can make with the vocal organs. As a proof of this, notice the fact that the same letter takes a different sound according to the language in which it is used. True as this distinction is, however, it is very difficult to fix in the mind.

All tone is merely an interruption of sound. Vowels are made with the mouth open, while consonants are not properly sounds at all, being simply interruptions of the basal sound by some part of the vocal system. This is a fundamental discrimination.

These sounds, *e*, *a*, *ah*, *o*, *oo*, constitute the fundamental vowel sounds of the world. The Sanscrit language omits the *a* and *o*, which leaves *e*, *ah*, *oo* as fundamentals. All other vowel sounds are simply modifications of these.

Various discriminations of sound may be made. Take, first, the fundamental distinction between vowels and consonants; next, sounds produced by the front mouth, the middle mouth, and the back mouth; then simple breath sounds, as the short *p*, *t*, *k*. In these is noticed the unintoned breath—that is, sounds produced with the larynx relaxed—without tone; but tone is evinced when you say *b*, *d*, *g*, for in these we have a tension of the vocal cords. Finally, with tense vocal cords and open nasal passages we have nasal sounds. These are both consonant and vowel. They are not heard in English; but constitute the chiefest difficulty to be overcome by the student of the French language.

Next in the order of the "Transactions" occurred a paper by Dr. Farrar, of Brooklyn, which has been withdrawn from publication by its author.

The Secretary read the following paper :

THE CASE OF THE WISDOM-TOOTH IN RELATION TO THE HYPOTHESIS OF THE ULTIMATE SUPPRESSION OF THE TEETH IN MAN.

BY A. H. THOMPSON, D.D.S., OF TOPEKA, KANSAS.

[*Abstract.*]

In the literature of the dental profession much has been written upon the wisdom-tooth; but little has been done toward the explanation of its present degeneracy and defectiveness in man. For this explanation the facts or data which we possess are, unfortunately, meagre; but, while regretting the paucity of recorded observations, from which to make deductions, we are therefore more strongly urged to the study of the meanings furnished by them.

The wisdom-tooth originates, like the other teeth (according to some writers), directly from the epithelium and corium of the mucous membrane; but, according to others, partly from the enamel germ of the second molar.

It is exceedingly irregular in the time of its eruption. In a few cases it has appeared as early as the twelfth year, and has, on the other hand, failed to erupt until the eighty-fifth year. Irregularity of number is also a common abnormality—one, two, three, or all, occasionally being absent. Supernumerary wisdom-teeth are also found.

Irregularity of direction in the mouth is quite common, probably owing to insufficiency of space. Such malpositions often give rise to excessive irritation and inflammation in the surrounding soft tissues.

The wisdom-tooth is also irregular in form and structure, being usually defective or imperfect in both particulars. It is also very prone to decay.

In making deductions from these facts, we find two central, principal points indicated. First, the gradual disappearance of the wisdom-tooth, through its own innate defectiveness; and, second, the premature contraction of the jaw, contributing also toward its coercion. The fact that the wisdom-tooth is disappearing in man is believed by many writers, and is gradually gaining ground in the intelligent belief of the profession.

In comparative observation we find that it is more or less defective in all the *primates*, from man down to the apes. In the latter it is a quite perfect and functional tooth, but with a slight tendency toward lessening in size, in some of the higher forms. This early tendency toward reduction is, it is true, slight; but it is still plainly perceptible. In the lower races of mankind it is still perfect and serviceable, and there is a plenty of space in the jaw for its accommodation—as is also the case with the apes. The tendency toward lessening is yet unmarked in the lower human races; but the difference between these and the apes is less than between the same races and civilized man.

Passing to the latter, we now find a very great change. Here the condition of this tooth is much degraded, in comparison with the lower *primates*, and its space in the jaw is much reduced.

The cause of the deterioration of the wisdom-tooth in man, and of the contraction of the jaws, must be found in the workings of those great forces which influence all animated nature, and which are urging the wisdom-tooth toward suppression, and influencing the remainder of the teeth in the same manner. These are factors of the great principle of evolution, and must be recognized. One of the most active forces in this work is *disuse*. The increasing disuse of the jaws and teeth has led to their gradual reduction, with a tendency toward final suppression of the teeth. This has operated in an especially active manner upon the wisdom-tooth, so that in man of to-day it can scarcely be considered as more than rudimentary. This result has been brought about by disuse and the laws of economy of growth acting through hereditary methods and the transmission of accumulated effects; which laws, as stated by Darwin, are especially applicable to the wisdom-tooth. Correlated variation also influences the jaw toward reduction, through the lessening of the feet and hands in civilized man, with corresponding effects on the jaw. High feeding has also caused lessening of these parts, while likewise tending to perpetuate the rudimentary character of the wisdom-tooth.

In conclusion, it seems certain that the characteristics of the wisdom-tooth in man point toward its eventual disappearance from the human jaw; in which direction progress now seems far advanced.

DISCUSSION.

DR. KINGSLEY: The conclusions of this paper I cannot admit. There is no evidence to prove that entire absence of the wisdom-tooth has led to any contraction of the jaw. There seems to be, by the advocates of this theory, a confounding of the teeth and the alveolar process with the development of the wisdom-tooth. These are, in reality, distinct things. The mere fact of the occasional non-appearance of the wisdom-tooth is altogether too slight a foundation upon which to place the assumption of its final disappearance.

Dr. Rich (*New York*): I have never heard an intelligent explanation of the cause of the non-appearance of the wisdom-tooth. I never fail to find, where there is good general organization, a wisdom-tooth in good condition. Of course, in the cases of imperfect development, springing from parents not capable of producing perfect development, there will appear irregularities of the teeth, as well as of other organs. There is no deterioration of the human system, except where there is imperfection of development. Where there is little vitality in the germ there will be deficiency in results.

Dr. Atkinson (*New York*): Every tooth which I have examined microscopically has shown the existence of distinct enamel and dentinal membranes—in fact, a double membrane. But many have a membrane which is never called into activity by the proliferation of the bases of the enamel roots. There is a class of eels which have only a tip of enamel on the ends of the teeth; but if the membrane is pressed down the double membrane is revealed. There is presented the zonic space, indicated by a corium so dense, that it is doubtful whether or not it is fully calcified cementum, resultant upon the precedent capsule.

What is the nature of development? If children are so fed that they do not fully exercise their jaws there may be absence of the wisdom-tooth simply from lack of its development by use, although it may have been originally well developed. We had better not attempt to decide such things as this paper treats of, until we understand better than we now do the laws of normal development.

Dr. Elliott read the following paper:

CHINESE AND JAPANESE DENTISTRY.

BY W. ST. GEORGE ELLIOTT, M.D., D.D.S.

The following, on the dentistry of the Chinese, was written by Dr. Rodgers, an American dentist in Hong Kong, assisted by Dr. Kerr, an American missionary physician in Canton. It has been published only in the *China Review*, and will, therefore, probably be new, and, I hope, interesting to you.*

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*Dr. Elliott is mistaken as to the previous non-appearance of this article in America. It will be found reprinted in the *Cosmos* of July, 1877, and in various other publications.—Ed.

馬螂蠁	Ma-long-héung.
川烏	Ch'ün-ú.
草烏	Ts'ò-ú.
生半夏	Shang-pún-há.
白芷	Pák-chi.
川芎	Ch'ün-kung.
土狗	T'ò-kau.
白芍	Pák-chéuk.

"The practice of dentistry in China is doubtless very ancient, but it has not attained to the perfection which characterizes the modern art as practiced in the West. It is, however, supposed that the Chinese operator is possessed of superior skill in certain points, to which his Western brother has not been able to attain.

"Inspired with zeal for an increase of knowledge, and desiring to perfect ourselves in the art of relieving human suffering and repairing the defects of human teeth, we proceeded, on the 9th of March, 1876, to the Temple of Horrors (Shing Wong Miu) in Canton, where Chinese dentists do congregate. We had in our minds three points which we wished to investigate: *First,* the cure of tooth-ache by taking out worms; *Second,* painless extraction of teeth; *Third,* insertion of artificial teeth.

"I.—It is well-known that the Chinese attribute tooth-ache to the gnawing of worms, and that their dentists take these worms from decayed teeth. Western physicians are disposed to believe that there is a little jugglery about it, having never been able to detect worms in the cavities of teeth. But how the dentists performed the trick (if it was one) and so artfully concealed it in the hurry of daily business was a secret, and to discover this was one object on which we, on this occasion, had our purpose fixed. We met with a rather intelligent-looking member of the profession, from whom we obtained a lot of artificial teeth, and Dr. R. desired to obtain a complete kit of the tools used. In order to avoid the crowd we invited him to a restaurant, where, over a social cup of tea, the matter was, with some difficulty, arranged. On the following morning the man made his appearance with the coveted implements, bringing also a lot of the worms, and proceeded to instruct us how to use them. His instructions or explanations were in full accord, as far as we were able to see, with our personal observations, as we remained for a considerable time to examine and study their practical operations, several patients being treated in our presence. When a patient with tooth-ache applies for relief, if the tooth is solid in the socket, the gum is separated from the tooth with sharp instruments, and made to bleed. During this operation the cheek is held to one side by a bamboo spatula, both ends of which are alike, and on the end held in the hand some worms are concealed under thin paper pasted to the spatula, the paper being the same color as the spatula. When all is prepared, this end is adroitly turned and put into the mouth, and the paper, becoming moistened, is very easily torn with the sharp instrument used for cutting the gums, gives up its worms, which mix with the bloody saliva, and the dentist leisurely picks them out with a pair of forceps. The patient, having ocular demonstration that the cause of his disease has been removed, has good reason to expect relief: which, in most cases, would be the result from the bleeding of the gum and the fright of the patient.

"When the toothache returns, as it will in almost every case, perhaps within an hour, or, may be, not for one or two days, the patient again seeks his dentist for relief, and the same operation is performed, finding more worms, which, of course, explains the recurring trouble; and this is continued from time to time until the tooth ceases aching altogether of its own accord, from the natural death of the pulp. These worms are manufactured in quantities to suit the trade, and they are very cleverly done: yet, to fully carry out the delusion, the dentist is obliged to keep on hand a few live worms to show his patients, explaining that most of the worms taken from the tooth are killed either by a powder they often apply to the tooth (it may be said that there is no virtue in the powder used), or by the process of taking them from the tooth with the forceps. Another fact might be mentioned: the standard medical books of China teach, and have taught for ages, the idea of worms in a tooth causing it to ache.

"The above practice is resorted to when the tooth is firmly set in the jaw, or is not so loose as to be removed with the finger, or by a slight force or pressure with iron instruments, which will shortly be described. This, our friend informed us, was an imposition; for he assured us that they could not extract teeth that were solid in the jaw.

"II.—The painless extraction of teeth is accomplished by the application of a powder to the gum, which is said to loosen the tooth so that it may then be removed, after a little time, with the thumb and forefinger. The powder is useless, and applied only to deceive the patient. This corresponds with what we had long known—viz., that unless a tooth has already become very loose, the Chinese have no means of removing it. They do use a pair of forceps with flat jaws, but they must conceal them in a cloth, because the patients are taught that no instruments are used in removing a tooth, and they are of no use unless the tooth has become quite loose. Our friend had another instrument, which was merely a flat piece of iron, with a hole in one end of it, the use of which was to hook on the canine teeth when they were irregular, and, by a sudden jerk upwards, remove them. We saw a tooth removed in this way, but the instrument was concealed; and it was done so cleverly that we could not find out at the time how it was accomplished.

'In the above-mentioned case the dentist applied a powder to the gums quite freely at three different times, at each occasion letting it remain from five to ten minutes. We watched the case very closely, and concluded, from the dentist's movements, that he was about to extract the tooth: so, while he was looking for his instruments, and a cloth to conceal the same, we took the liberty to open the patient's mouth, and closely examine the tooth and gum, and, as was expected, found the tooth and gum positively unaffected. This powder was used for no other purpose than to deceive the patient and those observing the operation. In using the thumb and forefinger, or either of the above instruments, in twisting or pushing the tooth from its attachment to the gum, the tooth sometimes falls upon the floor of the mouth, and the patient spits it out at once: but more frequently it is left slightly attached to the gum. The tooth is then readily freed from its attachment by an almost unconscious or instinctive push or jerk of the tongue, and at the same time the tooth drops from the mouth. Sometimes, however, when the tooth is not so loosened as to drop or be pushed out by the tongue, a little folded or twisted bit of paper is used, one end of which is so adjusted in the mouth, that when the patient closes his teeth, which he is instructed to do, the loose tooth strikes or bites upon it; the operator then gives the paper a quick pull, and out falls the tooth.

"In the removing of this canine tooth, the dentist, after applying the powder to his entire satisfaction, returned with a small piece of cloth, in which was concealed the flat iron instrument with a hole in one end, as described above. This he kept in his right hand, and in his left he had a piece of paper folded over a bit of some kind of wax, pressed flat. This wax is called toothache plaster, and has in it some supposed charm or power to help loosen the tooth. After the powder had done its work, the dentist then struck the patient several light blows in quick succession upon the cheek, just behind the region of the tooth to be removed, with this charmed toothache plaster. This was done to divert the attention of the patient for the moment, while at the same time, with his right hand, he appeared to be rubbing the gum with this cloth, but, in fact, was adjusting the instrument upon the tooth; then, with a very quick jerk upward and outward, he dragged the tooth in part from its socket (the patient wincing considerably). This upward jerk was so quickly and adroitly done that it would be quite liable to deceive a close observer, having the appearance, at most, of an accidental catch on the tooth, or, perhaps, a hasty movement of the hand from the patient's mouth up over his head, as the operator stepped hurriedly back to his traps, which were lying behind the patient, as though he was in quest of another toothache plaster, which, in fact, was the case; and on his return he went through the same operation as before, and out came the tooth.

"There are many kinds of powders used by different dentists; but, as our friend confessed, they are all a sham. The recipe for the one he uses is [given at the head of this paper].

"III.—The insertion of artificial teeth has been practiced in China for ages before it was introduced into Europe, and has one great recommendation—viz., cheapness. In this respect our Western dentists cannot rival the operators of the Flowery Kingdom. The material used is bone or ivory; and the tooth, having been sawn and filed into the proper shape, is fastened to the adjoining teeth by a copper wire or catgut string. If two or more teeth are required, they are made in one piece, and a hole drilled the whole length, through which a double string or wire is passed, which loops over the natural tooth at one end, and is tied to the tooth at the other. This work, although rude in the extreme, is, as to looks, better than the absence of the teeth, and is of some use in mastication.

"The cost of a single tooth will be from five to ten cents, and the charge for half a dozen would be from thirty cents to half a dollar. At these low rates all classes may avail themselves of the benefit; and those who practice the art do a thriving business."

The dentistry of the neighboring country of the Japanese, although at present much in advance of that of the "Celestial Kingdom," was probably introduced, in common with all their early arts and sciences, from China. Indeed, most, if not all, of their scientific books, are in the syllabic language of the older nation.

In neither country is attempted the treatment of dental caries; and, of course, those diseases requiring more complicated treatment are likewise entirely neglected. Even the removal of tartar is not attempted; and the Japanese, although they pay much attention to the external appearance of their front teeth, make no effort to remove deposits from those parts not seen. It is to the almost universal presence of tartar that the early loss of their teeth may be attributed. The food of both the Chinese and Japanese is of a nature to allow the uninterrupted deposit of calcareous matters on their teeth; the vegetables and fish, of which their *ménu* is almost entirely composed, not being of a nature to interfere mechanically, in mastication, with such formations.

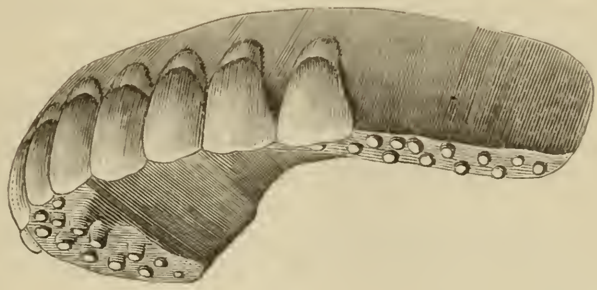
As the Japanese have no forceps, the teeth are generally extracted only when loose. Arsenic is sometimes used for the purpose of rendering their removal easy; but, like the Chinese, some inert powder is more usually employed, for effect on the the patient and multitude, the main reliance being on the fingers. When it becomes necessary to remove a firmly-fixed tooth, a stick is placed against its sides in alternation and struck quickly with a hammer; which plan is sometimes successful.

In a paper published by the writer in the *Cosmos*, during 1871, a general description of the manufacture of artificial dentures in Japan was given; hence the subject will be only slightly noticed here.

Partial dentures requiring a plate are seldom made. Where incomplete dentures are required, the proper number of teeth is carved, in one piece, from a block of bone, ivory or stone, and retained in position by strings fastened to the adjoining natural teeth. It has always appeared strange to me that the Japanese do not use the plate in partial dentures, when I consider their great success with the full plates, retained only by suction. I have been unsuccessful in my attempts at discovering when this principle was introduced among them; but it is probably of considerable antiquity.

When a full or nearly full denture for either jaw is required, the native dentist takes an impression in wax. This, hardened in cold water, serves to form a model, also in wax. The general shape of the required denture having been roughly carved in a hard, close-grained wood, it is applied to the model, which is covered with a coating of paint (called *beni*). Wherever the paint shows contact, the wood is carved away, until, by the uniformity of the contact, it is considered sufficiently prepared for the next step; which is simply a repetition of the first process, with the exception that the mouth of the patient is now used, instead of the wax model. The result is an easily-fitting, light plate, with good suction. At one time I employed this method, to a limited extent, with vulcanite, and have thus corrected a misfit.

As will be noticed in the cut, the wooden plate is made much larger than we would make it, the necessary fullness being not given (as with us) by the teeth. In Japanese artificial dentures these are intended solely for ornament, the plate behind coming quite up to their cutting edge, and fully supporting them. They are carved from bone or ivory, strung together on a string, and let into the anterior part of the plate by carving. Only front teeth are thus carved, the grinding surfaces being formed by the wood, into which is driven a number of nails on either side, the unequal wear of the wood and metal furnishing the necessary roughness of surface.



Native dentistry is largely practiced in both China and Japan, particularly in the latter country; where, as artficial dentures are efficient, as well as very cheap, they are largely used. Dentistry, as we know it, is practiced by only a few who have received some foreign instruction. I may mention a young Japanese physician, who remained with me as an assistant for several years while I was practicing in Yokohama. He is now settled at the capital, Tokio, and has acquired a very large practice. His stock of instruments and appliances is probably as good as we find in the majority of home offices. He has the honor of being the first native dentist who has received thorough foreign instruction.

Adjourned.

Society Notices.

The Secretary will be greatly obliged to all gentlemen desiring to read, or have read, papers before the Odontological Society during the ensuing year, if they will notify him promptly of the fact, giving the titles of the papers, so that the programme for the year may be satisfactorily arranged.

Address Albert H. Brockway, M.D.S., No. 13 Greene Avenue, Brooklyn, New York.

Society Correspondence.

ON THE MECHANICS OF SPEECH.

Max Müller, in his valuable work on the *Science of Language,* introduces to us a series of diagrams illustrative of the mechanism of articulate speech. So completely has he reduced his theory to practice, that by the study and application of his method or system, any one may learn to speak with facility and correctness any known language.

Favarger, in this city, taught his pupils to speak French with remarkable facility, by a system of his own, somewhat similar to that of Müller. He, a Franco-Swiss, mastered our language so completely that no one would presume but that the English was his native tongue.

Prof. Helmholtz has made many interesting discoveries in the same direction; and, more recently, Hovelacque has made most valuable contributions upon the subject.

I congratulate Dr. Kingsley that he has profited by the teachings of those who have gone before him in this beautiful field of investigation. No one is more capable of doing so than he. The department and the specialty which he cultivates so carefully peculiarly qualify him for this subject. A man who, taking a person who is practically dumb, will make his vocalization so complete that it cannot be distinguished from the trained language of the best speaker—who is enabled to catch the fractional part of a tone in articulation, and by his mechanism permanently fix it—is abundantly qualified to occupy this interesting field of labor.

Müller's diagrams are only approximately correct. Dr. Kingsley has made his own as absolutely so as possible, by an ingenious method, the action of which is its own best demonstration. The great factor that the pharyngeal wall, by advancing and receding during vocalization, materially aids in its process, was entirely left out by all his predecessors. The discovery of this new function is a remarkable one.

By understanding the principles shown us, and adapting them to our profession, we shall be enabled not only to avoid all possible occurrence of mal-articulation in our own mechanical departments, but to correct it in those of others. More than this, in all cases of congenital deformities of the mouth we may, according to our ability, follow in his footsteps, and divide the honors with him in restoring and blessing the subjects of our charge. Hovelacque has declared that the original motive power of speech is peculiar to man, and resides in a special localized part of the brain. Monkeys, chimpanzees and parrots have it not. The deaf mute has it, but, being deaf, he cannot articulate language, because he is unable to reproduce tones. The parrot may give the sound, but it is a mere *echo,* and without intellectual comprehension.

I have just referred to the deaf-mute, and this brings to my mind that they, in common with all persons afflicted with deafness, belong to a class who are most earnest in their study of the *mechanics of vocalization.* We have been contemplating the *interior* mechanism of speech. They mainly study its *exterior* expression in all of its detail, and combined with its *tout ensemble.* They study the play of the mouth, every varying expression of the lips and the teeth, every change in the opening or closing of the oral orifice, the inspirations and expirations, the fullness and depression of the cheeks, the raising and sinking of the shoulders and chest, the smile, the frown, the action of the throat, the motions of the head, the expressions of the eye, the forehead, the nostrils, and the countenance generally. All these combine to render to the eyes of these careful and studious observers an intelligent and unmistakable language. But they must *see* you, to understand you. Women are better understood by deaf persons, as a rule, than men, for the reason that their faces are uncovered. A man with a full beard is a puzzle to a deaf-mute. I have often had deaf persons request me to turn my face to the light, so that they might better understand me. Deaf persons will select their pew at the church in order to distinctly *see* the countenance of the clergyman, so that, by combining what they partially hear with what they see and know of the mechanics of vocalization, they may understand him.

Deaf-mutes are enabled, by a trained study of the mechanics of vocalization, not only to learn languages completely, but also to articulate them perfectly, though they never hear the sound of their own voices, or those of their companions with whom they are conversing. It is on this principle that the schools for mutes are successful in teaching their pupils language, combined with intelligent and complete vocalization.

Let us, for a moment, consider a few of the rudiments of this system of ocular intercommunication. To the most superficial observer *p*, *b*, *m*, *f*, *v*, are unmistakable. By still closer observation he will be able to detect the articulate expression of every one of the vowels when pronounced silently. A little more study, aided by all of the surrounding auxiliaries of expression to which we have referred, will enable him to detect *c*, *d*, *s*, and, finally, all the rest of the consonants. Then comes the putting together of all of these expressions (which are directed only to the eyes); and then, if he is an apt scholar, he will find himself in possession of a new, independent and wonderful language. W. H. DWINELLE.

Editorial.

PROGRESS.

In December last, M. Raoul Pictet, at Geneva, accomplished the hitherto impracticable task of liquefying oxygen. Shortly before, M. Cailletet, of Paris, had achieved the same result with nitric oxide, acetylene and methyl hydride. And now these scientists have succeeded in reducing hydrogen and nitrogen, also, to the liquid form; thus solving completely one of the great chemico-physical problems of our time—the liquefaction of all the gases.

A brief description of M. Pictet's process is quoted from the New York *Tribune:* "Liquid carbonic anhydride (obtained in this form by the use of sulphurous acid, and at a pressure of four to six atmospheres) is introduced into a long tube, and has a temperature of 65° below zero. Air-pumps are then applied to the tube, and the carbonic anhydride freezes solid in the vacuum thus attained. Within this tube there is another of smaller diameter, through which oxygen is passed. The oxygen issues from a generator, where it is produced from potassic chlorate. The generator is in the shape of a large howitzer shell, capable of resisting explosion. The pressure in this apparatus may be carried to 800 atmospheres; but only 300 were required in the experiment (with oxygen). As the oxygen under this pressure of 300 atmospheres, after passing through the refrigerating tube, issued into air of ordinary pressure, a portion of the gas took the liquid form, and remained as a liquid at the extremity of the tube."

Hydrogen required a pressure of 280 atmospheres, and was converted into an opaque mist; while nitrogen, under 200 atmospheres, was fully liquefied. The degree of cold required and produced in these experiments is almost inconceivable, being estimated at—300° C., or—508° F., the most intense cold ever produced.

The present century, and particularly its latter half, has witnessed some of the greatest and most marvelous efforts of mind, as well as the most valuable of scientific discoveries, which have a place in history. The telegraph; the telephone; the phonograph; the spectroscope; the determination of the laws of the correlation of forces and the conservation of energy; the establishment of the fact that heat is a mode of motion, instead of the vital principle; the synthesis of organic substances; the continual elimination, from bodies supposed to be fixed and elemental, of still more elemental principles; the discovery of the moons of Mars;—these things form a wonderful record of fifty years. When we consider the innumerable and far-reaching results of each of these briefly stated inventions and discoveries, skepticism as to future achievements, no matter how improbable they may seem, receives a severe rebuke; for the very magnitude of our present results seems to free from all limit the possibilities of the future.

This is, pre-eminently, the age of science. The average citizen of to-day knows more of nature's principles and methods of economy than was understood by the "wise men" of only a few short years ago. The basal truths of science have become ordinary matters of public instruction to our youth. Mechanics, chemistry, physiology, are no longer sealed books to the multitude. The scientific lecturer now ascends the platform to confront an audience not only *au fait* of the principles of his discourse, but disposed, and in large measure able, to criticise severely even the most advanced positions which he may occupy. The scientific writer, as he addresses himself to his task, now feels that his work will be reviewed by more thousands of persons competent to judge correctly of his conclusions, than formerly there would have been scores. Even the physician, in his daily rounds, finds that the once mysteries of physiology and therapeutics are fast becoming matters of household knowledge. The discoveries of the learned have been great; but it is a question not easily answered, whether their knowledge of principles, and even details, has advanced in equal proportion with that of the people.

From these considerations it would seem evident that the aspirant for the honors of the present or the future cannot pursue a temporizing or unmodified course. The old fable seems to have lost its applicability; for, while the hare may have gained in cunning, the tortoise has vastly improved in speed. With so many and such able critics (and their number and ability is daily increasing), crevices in the scientific armor are quickly noted, and as quickly made use of to the confusion of pretenders. Only the utmost exertion, continuous, never faltering, and based on principles of absolute correctness, can now maintain any really advanced position.

Everything points to the fact that mind, more than ever before, is now the controlling force, while matter, in all forms, has become merely its agent. This may seem like repeating a truism; but attendance upon many of the meetings of our dental associations will show that truisms cannot be too often repeated. We are told that there is too much of science in dentistry; that theory is cultivated to the exclusion of practice; that dentists are not, and need not be, doctors or surgeons; that it is the province of dentistry to *save* teeth.

It appears to us that these objectors have lost sight of the idea originated by Hudson—the *prevention* of dental disease, rather than its *cure*. Viewing the question in this light, how is it possible for dentists to be too well acquainted with, not only the general laws, but the minute details of, anatomy, physiology, pathology and therapeutics? The province of dentistry is surely enlarged and ennobled by the admission of principles and operations which look rather to the abolition of disease, than to its cure after occurrence.

It has long been held that filling a cavity in a tooth is synonymous with treating dental disease. It is so—in the same sense as that bandaging a wound or tying an artery is the treatment of the systemic lesion in which the operation occurs. The bandage and the ligature are only steps in the process of treatment—and only primary steps. The disease itself is combatted by other and more complicated means,—means requiring more various remedies, more thought, more knowledge, more extensive special education. In so far as the excavation of a cavity has mechanically removed diseased structure, there has been treatment; but no farther. Any consequent cessation of diseased action in that tooth has not prevented extension of the trouble to its neighbors, nor, in most instances, the recurrence of the abnormal condition in itself. In short, the disease has been only temporarily obstructed, not permanently abolished.

Again, can we have too much of science, too much of theory, in dentistry? Is it not at once apparent that every well-considered and correctly-based theory will surely tend to widen the field and enlarge the capabilities of practical work? What practice has ever been, or can ever be, successful, which has not been founded on truthful theoretical deductions? No one will deny the immense importance of proper manual ability in both the operative and mechanical departments of the specialty; but it is certain that these are entirely dependent, for fullness and excellence of results, on the theoretical principles upon which they are founded.

It cannot be, then, that tooth-filling, or even tooth-saving, shall constitute the *ultima thule* of dentistry, or that the profession will remain satisfied with only partial results. Nor will it be so. The note of "advance" is heard on every hand. The titles "oral surgeon," "oral science," excite now more of intelligent discussion than they formerly did of ignorant ridicule. The practitioners of our mother science are beginning to discover that there is a specialty of medicine called "dentistry." The public is fast awaking to the fact that a knowledge of the treatment of oral disease is not confined to doctors of medicine. And, finally, dentists themselves are becoming aware that there is more in the capabilities and field of their profession than has heretofore been clearly apparent to themselves. It is evident that dentistry, fast as it has grown within the past fifty years, will grow much faster in the future, especially in the direction of really scientific attainment; *not* to the detriment or exclusion of operative ability, but to its immense advantage, in directing to a better end, and with more certain, lasting, and valuable results, the skilled fingers of the dentist.

ANNOUNCEMENT.

Drs. E. A. Bogue, of New York; Geo. T. Moffatt, of Boston; C. D. Cook, of Brooklyn; and G. C. Daboll, of Buffalo, have opened a dental office at No. 39 Boulevard Haussmann, Paris, France.

Surgical and Medical Selections.

A LECTURE ON THE PRESENCE OF BILE IN THE SALIVA.

BY SAMUEL FENWICK, M.D., M.R.C.S.,

Physician to, and Lecturer on Medicine at, the London Hospital.

We have seen that in persons affected with jaundice, the coloring matter of the bile can be readily proved to exist in most of the structures and secretions of the body, as well as in any inflammatory exudations that may be present. It has, however, been denied that bile is ever found in the saliva. It is true that Huxham, Fourcroy and Budd described this secretion as occasionally of a yellowish or greenish color in this disease, but the fact has been disputed by Frerichs, Murchison, and most of the later authorities on diseases of the liver. If you collect a considerable quantity of the saliva of a jaundiced patient, you will not, as a rule, be able to distinguish any difference in color from the salivary secretion of a healthy person. In rare instances I have seen it of a greenish or yellowish hue, but I think this was only where decomposition had commenced. This is probably the explanation of the colored saliva mentioned by Huxham and Budd; for in both of their cases salivation had been produced by mercury, and we may, therefore, presume that decomposition had been set up. But if you evaporate the saliva of a jaundiced patient in a water-bath, the residue is usually of a yellowish color, the coloring matter being soluble in chloroform, and apparently identical with the coloring matter of the bile. In some cases, as where the jaundice is intense, it is sufficient to shake up the saliva with alcohol, and throw it in a filter of white filter-paper. As the ring formed by the alcohol evaporates, a yellowish stain may be observed.

A boy was lately admitted into the hospital with jaundice of five or six weeks' duration. The skin, conjunctivæ and urine were intensely yellow. He was ordered to collect as much of his saliva as he could, and about one ounce was obtained, which, on evaporation, left a yellow residue. He was now subjected to treatment, and in ten days the color had disappeared from the skin and urine. The saliva was again collected, and although the jaundice had apparently gone, a small proportion of pigment was still visible when it was evaporated.

I have examined the saliva in a large number of cases of jaundice, and, whenever the disease has been recent, have found the pigment on evaporation. The amount, however, varies, and in a few chronic cases, where the liver has been much destroyed, as by cancer, the color has been slight, or entirely absent. At different periods of the disease the quantity has increased or lessened, probably in proportion to the amount of obstruction of the duct. In some cases the residue on evaporation has been yellow; in others of a reddish-brown. Thus two women of middle age were under my care at the same time. One had been jaundiced for fifteen months, had lost a great deal of flesh, and the liver could be felt to be much enlarged. Her saliva on evaporation left a light yellow residue. Under treatment she gradually improved, the jaundice left her, she became stout, and, although a hard mass can be now felt in the region of the gall-bladder, she remains quite well. In the other the complaint was of a few months' standing, and the saliva afforded a reddish-brown residue. No permanent improvement occurred, and she returned to the hospital nine months afterward, and died of scirrhus of the pancreas, obstructed duct, and atrophy of the liver. You might suppose from this that the different shades of color in the saliva might be an assistance in diagnosis or prognosis; but such is, I think, not the case, for I have seen the brownish-red color in the saliva of persons suffering from recent jaundice who have perfectly recovered.

You will remark that the pigment could be still detected in the saliva of the boy whose case I just mentioned to you, after the jaundice had apparently disappeared. I have convinced myself by other observations that this is not an uncommon circumstance, and you will naturally ask how it is to be explained. Merely, I believe, because you can detect a small amount of pigment in a colorless secretion like the saliva, when a slight trace cannot be recognized in the urine.

There are, as you know, two coloring matters in the bile—the bilirubin and the biliverdin—the latter being an oxidized form of the other. In the cases I formerly mentioned to you, where an hydatid cyst communicating with large hepatic ducts had perforated the diaphragm so that the bile had entered the bronchial tubes, the sputa were of a very bright orange color. We may consequently assume that the bile, when newly secreted, contains only the yellow pigment, and it is this which appears in the saliva in jaundice. At any rate, out of a great number of observations I have only once seen the residue left by evaporation of a green color.

The discovery of the coloring matter of the bile in the saliva of jaundiced persons throws an interesting light upon another point. You know there is no more common subject of complaint amongst patients than what they term "biliousness." They tell you their "livers are out of order," and, in proof of it, point to a yellowness at the back of their tongues, which is most observable in the early morning. The practitioner, on the contrary, often sees in such cases no evidence of disordered hepatic action. He finds the suspected organ normal in shape and size; the skin and conjunctivæ are not yellow, or only slightly so; and the urine, though high-colored, affords no indication of the presence of bile. But in the boy whose case I have quoted the saliva contained pigment when the jaundice had apparently disappeared; and it seemed to me that it would be interesting to ascertain if the saliva were in a similar state in persons who are what is termed "bilious."

A young woman had suffered for six weeks from pain of the chest, flatulence, and other signs of dyspepsia, the back of her tongue being coated and yellow. Some of her saliva was collected, and, when evaporated, afforded a residue of a yellowish color, which was soluble in chloroform, and was apparently biliary pigment. This experiment I have tried with other persons in a similar state, and with the same result.

Now you will readily see why the back of the tongue should in such cases present its yellow hue. During the day the saliva is swallowed as quickly as it is secreted; but in the night only enough enters the mouth to keep the mucous membrane moist. The heat of the mouth evaporates it, and thus the same result is obtained as when we operate upon the saliva in the laboratory.

We have only proved that the coloring matter is excreted by the salivary glands; but you will remember that the biliary salts are far more important constituents of the hepatic secretion than the pigment. They represent the greater part of the unoxidized sulphur that results from the disintegration of the albumen of the tissues, and are distinguished by an intense bitterness of taste. As these salts have been found in the urine in jaundice in small quantities, and as a bitter taste is occasionally experienced by persons affected with this disease, we might anticipate that they would be capable of discovery in the saliva along with the pigment. I have examined the saliva of a considerable number of jaundiced persons, by treating the residue obtained by evaporation with boiling alcohol, and, after filtering and evaporating, testing it with Pettenkofer's test. In some instances a doubtful result was obtained; but when the plan of adding ether to the alcoholic solution was observed, so as to precipitate the biliary salts, no evidence of their presence could be found. This might arise either from the biliary salts being present only in very minute quantities, or from the amount of saliva operated upon being too small; for the following case proves that they may be excreted by the salivary glands.

A gentleman belonging to the medical profession, aged seventy-three, consulted me for an intensely bitter taste he had been annoyed with for many months. The skin, conjunctivæ and urine were uncolored; he had never suffered from jaundice, and was, excepting this, in perfect health. The bitter taste was constantly present, and he always found it to be increased after taking alcohol in any form. I requested him to collect as much of his saliva as he could, and he sent me about two ounces. This was evaporated, and left no yellow stain. The residue was treated with boiling alcohol, which was filtered and mixed with ether in a stoppered bottle. In a few days a fine precipitate had formed, which, when removed and dissolved in water, afforded the characteristic color of the biliary salts, with sulphuric acid and sugar.

Now if we are to look upon jaundice as consisting in the presence of the hepatic secretion in the blood, this was a case of jaundice without the presence of the yellow color usually supposed to be characteristic of it. What is difficult of explanation is that the biliary salts must have been present in the circulation for many months without any deterioration of the general health. We are told that these salts, when injected into the blood, produce jaundice, hemorrhage and slowness of the pulse; but there were no such symptoms in the gentleman in question.

The detection of the biliary salts in the above case seems to throw light upon those cases of "biliousness" in which bitterness of taste in the early morning is a prominent symptom. But you may fairly object that the presence of either the biliary pigment or of the taurocholate of soda in the circulation is insufficient to explain many of the symptoms from which a bilious patient suffers; for slight jaundice may be present for a considerable time without any great deterioration of the general health. You must remember, however, that under normal conditions the biliary salts are re-absorbed and decomposed in the circulation, and we may, therefore, suppose that in most bilious persons any excessive secretion of taurocholate of soda by the liver will be followed by an increased production of secondary sulphur compounds in the blood. Now I am led by various experiments to believe that most of the symptoms recognized as arising from an excessive secretion or undue retention of bile in the organism, are the result of an injurious action produced by these secondary sulphur compounds on the tissues. This subject, although most interesting, is far too wide to be discussed in the present lecture; but I hope on a future occasion to bring it under your notice.—*The Lancet.*

TWO CASES OF EPITHELIOMA OF THE TONGUE.

Excision—Recovery.

BY J. C. OGILVIE WILL, M.D.,

Surgeon to the Aberdeen Royal Infirmary.

Case I.—A. D——, aged fifty, gardener, was admitted to the Aberdeen Royal Infirmary on December 20th, 1876, complaining of a tumor of the tongue. About four months previous to admission patient began to feel at times a sharp, pricking sensation at the upper part of the right margin of his tongue, opposite the second lower molar tooth, as if a "sid" or little bone had stuck in the side of his tongue, and produced this sensation when brought in contact with the adjoining tooth. No attention was paid to this, as the pain was but rarely felt, and was only momentary. It was not until six weeks ago that he accidentally discovered the swelling by feeling it with his finger, so small was its size, and so little inconvenience did it occasion. The patient forthwith went to a druggist, who burned the part with caustic, and gave him a piece of the same substance, telling him to repeat the process *ad libitum*, which was duly done, but with, as may be supposed, no good effect. The patient has been a healthy man; never had any venereal complaints; has been a free liver, and is a smoker. No history of malignant disease in his family. Four days before admission he had a pretty severe attack of hæmoptysis, and he continued to cough up bloody sputa for three or four days after admission; but when I first saw him, about a fortnight later, his cough had disappeared, and nothing but slight, moist bronchial râles were discoverable.

Appearance on Admission.—There is a small tumor, about the size of a sparrow's egg, on the right margin of the tongue, opposite the last molar tooth, by which it is indented. The swelling is hard to the touch, especially at the back part, where it extends towards the mesial line of the tongue. The right lower molar presents a sharp, jagged projection over its crown, a part having broken off some time before. The edges of the other molars, both above and below, on the right side, are all more or less sharp. No indurated glands can be discovered.

Treatment.—Dr. Garden, who was acting for me, as I was unable to attend hospital, ordered the sharpest tooth to be extracted and the others to be ground down; after this had been done, the irritation slightly subsided, and the pain was much diminished.

On Jan. 17th, the patient having been brought under the influence of chloroform, an incision was made through the middle line of the lower lip, extending about an inch below the chin. The soft parts were then slightly dissected from the bone, the symphysis of the jaw was sawn through, and the rami pulled aside by two loop bandages. Two strong ligatures were passed through the tip of the tongue, one on either side of the middle line, and it was drawn well forward, upward, and to the left side, while its connections to the floor of the mouth on the affected side were being divided by a scalpel. The coronary arteries and one other vessel were tied with catgut. The tongue, being pulled outward by means of the cords, was then transfixed by pushing a scalpel through its root in the mesial line, and, by cutting forward along its centre to its tip, it was divided ino two equal halves. The wire of an écraseur was then passed round the base of the right half of the tongue, as far back as was possible, and, the wire being gradually tightened, the affected part was removed, no hemorrhage supervening. The jaw was then drilled at two points on each side, by means of a needle attached to a treadle drill, one hole passing through the lower part of the aveolus, the other through the body of the jaw. The divided rami were next brought into apposition, and kept in place by two strong silver wire sutures passed through the holes, and the wound in the soft parts was united by four harelip pins and a twisted suture. A drainage-tube was passed through the floor of the mouth, and brought out in front of the hyoid bone, and the raw surfaces within the mouth were well sponged with a solution of chloride of zinc, forty grains to the ounce. A feeding-tube was passed through the nose into the œsophagus, but its presence induced violent retching, causing its expulsion; and, on again attempting at a later period to re-introduce it, it was found to so irritate and disturb the patient, that I thought it better to abandon this mode of administering nourishment, and trust to feeding by the mouth. During the afternoon of the day on which the operation was performed the patient was quiet, and seemed to suffer but little; in the evening he swallowed a little milk with ease, and during the night he had egg-flip. He spent a tolerably quiet and comfortable night with the aid of a morphia suppository, which was repeated next night. His temperature never rose much above normal, except on the evening of Jan. 19th, when it reached 102° F., which was so far accounted for by his having got out of bed to shut the window of the closet in which he lay, which had been opened against orders.

On Jan. 20th, three days after the operation, the harelip pins and drainage tube were removed, and the union was found to be perfect. The putridity of the discharge, which was increased by the necessity of feeding the patient by the mouth, was held in check by the use of solutions of permanganate of potash and salicylic acid, and his strength was kept up by the free administration of beef-tea, eggs, milk and brandy. An external gutta-percha splint, padded with boracic lint, was applied to the chin, and kept in position by a bandage. On Jan. 23d the patient was able to leave his bed for a short time. On the 27th he was up for the greater part of the day, healing of the wounded surfaces being almost complete. On Feb. 3d he was allowed out-of-doors for a short time; and on Feb. 20th he left the hospital. At the date of dismissal articulation was wonderfully clear and distinct. For the notes of this case I am indebted to Mr. William Allardyce, whose attention to the patient was unremitting.

The notes of the following case were taken by Mr. W. S. Robertson.

CASE 2.—A. L——, aged forty-nine, a railway carter, was admitted into the Aberdeen Royal Infirmary on May 25th, 1876, suffering from epithelioma of the tongue. Patient has enjoyed perfect health, has never had any venereal complaints, and has a large family of healthy children. About three years ago the skin came off his mouth and tongue on account of excessive smoking. He smoked a common clay pipe, three or four inches long, and used three or four ounces of common twist tobacco per week. The abraded mucous membrane healed rapidly, without the aid of treatment. About three months before admission he began to experience a burning sensation in the left margin of his tongue each time he smoked. On looking at his tongue he found a small red ulcer about the size of a pea. There was no swelling, but an increased flow of saliva. As the part did not show signs of healing, he applied to a medical man, who applied caustic to it, and prescribed a mouth-wash. Soon after this, as the sore was evidently increasing in size, he sought admission to the infirmary. There is no history of malignant disease in patient's relations.

Condition on Admission.—On the left side of the tongue, about one inch from the tip, there is an ulcer about the size of a shilling. It is somewhat concave, has a rough, uneven surface, covered with grayish-colored granulations; the edges are hard and indurated, the induration extending toward the mesial line, and involving the tissues of the floor of the mouth on the affected side. Discharge is slight, but very putrid; the glands unaffected. Pain is only slight when the parts are at rest, but it is intense during mastication; and as he has lost his right molars, he has great difficulty in chewing. The left canine and lateral incisor teeth are much worn from the pressure of the pipes he was in the habit of smoking. The teeth corresponding to the affected surface are comparatively sound.

On May 31st an operation similar to that described in connection with the case above was performed, the only difference being the removal of the indurated portion, involving the floor of the mouth, which was readily accomplished by a few touches of a scalpel.

June 1st.—Patient has passed a quiet night, with the aid of two half-grain morphia suppositories; has taken white of egg and port wine through œsophageal tube. Temperature, 101.2°; pulse, 130.

2d.—Slept a good deal during day and night. No fetor. Morning temperature, 102°; evening temperature, 98.9°. Three of the harelip pins removed; healing is so accurate, that the line of the external excision can only be made out with difficulty.

3d.—Has slept well; no pain; to use chlorate of potash and permanganate of potash mouth-washes. Remaining pin, the submental one, and also the œsophageal and drainage-tube, removed. No difficulty in swallowing; cut surfaces in mouth look healthy, discharge somewhat fetid.

4th.—Good night; taking nourishment readily. Temperature, 98.9°; pulse, 88.

10th.—Improving rapidly, looks much better than before operation.

18th.—As there is still mobility between the divided portions of the inferior maxilla, a vulcanite interdental splint was applied by Dr. Williamson, with an external gutta-percha one fitted to the chin. After this apparatus was applied union was rapid, when he was dismissed from the hospital.

Remarks.—The merit of suggesting the mode of operation adopted in the foregoing cases should be ascribed to Mr. Annandale, of Edinburgh, for it was he who first perfected it in all its details, evidently taking as his groundwork the original suggestion of M. Sédillot as to the main steps, replacing angular division of the jaw by Mr. Syme's more simple mode, adopting Dr. George Buchanan's practice of splitting the tongue into two halves, using the écraseur in place of the knife for accomplishing removal of the affected part, and retaining the divided jaw by silver sutures, instead of trusting to bandages or splints. From a recent report of the proceedings of the Edinburgh Medico-Chirurgical Society, I see that Mr. Annandale has lately used Paquelin's thermo-cautery with success in this operation, and in my second case I thought of trying it, and, through the kindness of Dr. Angus Fraser, I had the instrument at hand; but the close proximity of the larynx and the fear of the effects of radiation made me doubt the expediency of employing it. Some surgeons—amongst them Prof. Spence—still adhere to the use of the knife; but the écraseur will recommend itself to most; for if sufficient time be allowed during the process of écrasement, there is not the slightest probability of bleeding from the lingual arteries proving troublesome. The tightening of the wire or chain of the écraseur should be very gradual, ten to fifteen minutes being the average length of time required;

if the instrument be worked quickly, hemorrhage is almost certain to ensue. A considerable number of cases where recovery followed after excision by this mode have been put on record lately by Mr. Annandale, Prof. Spence, and other surgeons. In some the whole tongue has been removed, in others a portion only. In addition to my own two cases, there have been two others in the Aberdeen Infirmary, under the care of Prof. Pirrie; in one the entire tongue was removed, in the other a half. In the former case progress was eminently satisfactory for ten days after operation; but chest symptoms unfortunately set in at this period, and the patient soon succumbed, the cause of death being gangrene of the lungs. In the latter case speedy recovery followed. In the fatal case inflammatory symptoms were first observed immediately after a sudden change in the atmospheric temperature, comparatively mild weather being succeeded by intense cold, and to this the untoward result was probably due.

In one of my own cases (Case 1) an accident occurred during the boring of the jaw, the needle breaking off in the bone. As it was evidently useless to attempt its extraction, it was allowed to remain; whether it will give rise to future disturbance still remains to be seen. I believe that it will not do so, for, as is well known, metallic substances may remain long in the body without any symptoms revealing their existence. This fact was particularly impressed upon me by an accident which happened during an operation for the cure of coccygodynia, when I was acting as assistant to the operator some years ago. During the division of the ligamentous structures the blade of the tenotomy knife snapped in two; an attempt to extract it on the day of operation, and also on the succeeding day, when division on the opposite side was practiced, failed, and the blade was left where it was, and its presence did not occasion any observable symptoms. The operator told me that a similar accident had occurred to him thirteen years before, and, though the blade was left, the result of the operation was perfectly satisfactory, the lady being still in happy ignorance of its existence. Notwithstanding the occurrence of the untoward event just noticed, I regard the treadle drill as the best instrument for drilling the jaw; for, though it is easy to perforate the jaw with a common pricker where the bony structure is cancellous, it is exceedingly difficult to do so when it is dense and compact; but the needle of a treadle drill goes through with great ease and amazing rapidity, and I think that it would be found equally useful in the case of other bones where drilling is required; and I believe that the field where the use of the treadle machine, with properly adapted cutting or gouging points, will prove advantageous, extends far beyond the domain of the dental department of surgery. The firm twisting of the wires, which should be thick and well-tempered, is materially assisted by seizing their ends with two pairs of common tweezers, as they are somewhat apt to slip when the fingers of the operator are alone relied upon. The removal of the wires when union has taken place is readily accomplished by seizing the ends of the wires with a forceps, and making forcible traction; untwisting the wires I found impossible, and I also saw it fail in a case in the Edinburgh Royal Infirmary; but traction succeeded without the exertion of much force or the causation of pain. The wires, if tightly twisted, will in most cases answer the purpose for which they are inserted; but the application of a splint, external, interdental, or both combined, will prove of service when the progress of union is at all doubtful.

The remarks which I have appended have already extended to too great a length; therefore I must bring them to a conclusion, with a statement that I believe this mode of operation to be the best yet suggested; that it is worthy of general adoption in all cases where partial excision for disease extending far back is required; that the entire tongue can be readily removed by it; but that the operation suggested by Regnoli, of Pisa, slightly modified by making a lesser incision, and encircling the root of the tongue with the wire of an écraseur, should, perhaps, be preferred when complete ablation of the organ is called for.—*The Lancet.*

TREATMENT OF THRUSH (APHTHÆ).

Dr. E. Ory (*La France Med.*) has collected the following formulæ. It must be remembered, in treating aphthæ, that certain affections of the digestive organs—troubles of nutrition, inflammation of the buccal mucous membrane, with augmented acidity of secretion—are conditions favoring the development of the fungus which constitutes the affection. The physician, therefore, must address himself as much to the general condition as the local affection. According to Blache, when the general condition is good, it suffices to touch the mucous membrane a number of times daily with the finger—or, better, a pledget of lint on forceps—covered with the following:

R. Glycerine (pure)—1 ounce.
Aluminis—80 grains. M.

The mouth should be frequently washed out with Vichy water, either pure or diluted with one-fourth part of milk; or, better still, with decoction of Krameria.

Trousseau recommends the following gargles:

R. Sodii borat.—½ ounce.
Mellis rosæ—½ ounce. M.

Or, better:

R. Potassii chlorat.—80 grains.
Mellis rosæ—½ ounce. M.

The honey may sometimes be replaced advantageously with syrup of Krameria. In rebellious cases Trousseau practiced cauterizations with nitrate of silver:

R. Argenti nitrat.—16 grains.
Aquæ destillat.—½ ounce. M.

This solution, however, is apt to discolor the teeth, and therefore may be advantageously replaced by solutions of the sulphates of zinc or copper.

Bretonneau used to use powdered calomel, mingled with mucilage, as a topical application. Dr. See rubs the affected spots with a bit of rag, and then bathes them with this mixture:

R. Glycerinæ—10 drachms.
Amyli—8 grains.
Sodii borat.—8 grains. M.

West indicates an analogous formula. He does not use preparations containing honey, on account of their liability to ferment:

R. Sodii borat.—30 grains.
Glycerinæ—1 drachm.
Aquæ, ad—1 ounce. M.

He applies this very carefully on a clean linen rag, after having had the mouth thoroughly washed out with warm water. In the rebellious forms he cauterizes with nitrate of silver solution, of the strength of about one grain to the ounce.

Parrot uses the following:

R. Glycerinæ—½ ounce.
Mellis rosæ—½ ounce.
Potassii chlorat.—1½ drachms. M.

Muller suggests:

R. Acid, salicylic—16 grains.
Glycerinæ—6 drachms.
Aquæ, ad—2 ounces. M.

—*Medical Brief.*

EPISTAXIS.

BY BOLLING W. BARTON, M.D., BALTIMORE.

To stop bleeding from the nose, it is not always enough to blow styptic or astringent powders into the nostrils; and injection of stronger agents, while it may stop the flow of blood, is often attended with very objectionable accidents. I believe that I once endangered the life of a patient by the injection of Monsel's solution into his nostrils. Some of the solution flowed back into the larynx and trachea, and produced most painful symptoms at the moment, and was followed by a degree of œdema of these parts which proved unpleasantly serious. The injection may have been done in a bungling manner; but even with skillful hands, it is easy to see that such an accident might happen. Besides this, the injection of this liquid is almost certain to give rise to quite profuse salivation; and, if it pass into the stomach, to vomiting, which is likely to undo all that has been done to arrest the bleeding. The last resort to which we flee when the simpler methods fail, that of the sound and tampon, is certainly most efficient in stopping the hemorrhage, but is also a most troublesome operation, if the patient should happen to be a peevish child. I have been told, also, that the presence of the tampon gives rise to peculiarly painful sensations.

In view of this heap of difficulties, I propose a simple method, to which the foregoing objections cannot be urged, and which has proved on three occasions all that could be desired in checking the nose-bleed. I used the Monsel iron solution, but applied it with feathers. The wing-feather of a common fowl is most readily gotten. The barbed end, of course, is dipped into the solution, and pushed rapidly back into the nostril, and turned once or twice in the fingers. In a few seconds the feather refuses to yield to pushing or pulling, showing that a firm clot has been formed. The projecting end is clipped, so as not to inconvenience the patient, enough of it being left to be easily seized and removed when required. If one feather should fail to stop the blood, a second may be introduced in the same manner, alongside of the first one. At the end of a certain time the clots slough away from the nasal walls, and may be removed without trouble.

This is a simple procedure, and I doubt whether it will fail when any other method would succeed.—*Medical Brief.*

Items.

New Remedy for Burns and Scalds.—At a recent meeting of the Massachusetts State Dental Society, Dr. G. F. Waters, of Boston, brought forward a new remedy for burns and scalds, and gave a most remarkable exhibition of its efficacy. The remedy consists simply of the bicarbonate of soda, such as is commonly used for cooking purposes. The doctor, by means of a sponge dipped in boiling water and applied to his right wrist, produced a very severe scald of about two inches in width and encircling the arm. A portion of this he rendered still more severe by retouching it with another spongeful of water. Upon the application of bicarbonate of soda, kept in place by a wet cloth, the pain was instantly stopped. On the next day the scald, excepting the doubly-cooked portion, was practically healed, the place being marked only by slight discoloration. The after-treatment of the more severely scalded part was simply wet cloths. No second application of the bicarbonate was made.

How to Introduce the Hypodermic Needle.—Dr. S. T. Allen, of White River Junction, Vt., writes: Placing the palm of the left hand beneath the patient's arm or leg, with the thumb and fingers draw the skin tight over the upper aspects of the limb, in which state you have an unyielding integument. Then, holding the instrument with the thumb and index finger of the right hand, place the beveled side of the point upon the place you have selected, at a proper angle with the surface; then, with a quick forward movement of the thumb and index finger only, keeping the hand immovable, thrust the point through the skin into the subcutaneous tissue. This manœuvre, if done quickly, will inflict little, if any, pain, and the patient will thank you, especially if he has been previously subjected to the almost universal method of pinching up a fold of integument for the puncture.—*Medical Record.*

Death from Ether.—The *Lancet* reports a case of death from ether, given preparatory to an operation for the removal of cancer of the breast. "After a few inhalations the patient's face suddenly became turgid and the hands white. The inhaler was at once removed, the tongue brought forward, cold water dashed over the face, and the chest rubbed with brandy; but the breathing became stertorous, the face more and more congested, the pulse failed, there was an effort at vomiting, and death took place within a few seconds." A post-mortem revealed the facts that "the whole of the upper surface of the liver was attached by old adhesions to the under surface of the diaphragm," and that the heart was "feeble and flabby," and had undergone fatty degeneration. "Mr. Sympson attributed the fatal result to failure of the heart's action, and the impairment of the functions of the diaphragm in consequence of its attachment to the liver."

FOREIGN BODIES IN THE THROAT.—A British naval surgeon, Dr. Beveridge, states that for foreign bodies in the throat, such as pieces of meat, etc., a simple mode of relief is to blow forcibly into the ear. This excites powerful reflex action, during which the foreign body is expelled from the trachea.—*Medical Brief.*

Obituary.

DR. GILBERT A. FOSTER.—Died at Utica, New York, December 7th, 1877, in the seventy-fifth year of his age.

Dr. Foster was born in Litchfield, New York, in 1802, and removed to Utica in 1832, where he resided until his death, having practiced dentistry since 1828. He was a prominent member of the profession in this State from an early day, being successively one of the original Fellows of the American Society of Dental Surgeons, first President of the Fifth District Dental Society, one of the City Council of Utica, and one of the American Dental Commissioners at the New York Exhibition of 1853. He was also, for twenty-five years, an active Mason, and was buried with high Masonic honors.

PROF. GEORGE T. BARKER.—Died in Philadelphia, January 10th, 1878, of typhoid pneumonia and spinal meningitis, in the forty-second year of his age. Professor Barker was born in Poughkeepsie, New York, in 1836. About 1855 he removed to Baltimore, and in 1856 became a resident of Philadelphia, where he remained until his death. In that city he was a student of Dr. Edward Townsend, graduated from the Pennsylvania College of Dental Surgery in 1859, and became one of the Faculty in 1862. He was Dean of the college in 1866-7, and until his death occupied its chair of Dental Pathology and Therapeutics. He was one of the editors of the *Dental Times*, author of a work on nitrous oxide, and a member of various societies.

Professor Barker was a man of remarkable energy, and displayed much originality of ideas. While his conclusions were not always acceptable to many, his honesty of conviction and candor of statement ensured the respect and warm regard of his professional associates.

RESOLUTIONS RELATIVE TO THE DEATH OF PROFESSOR GEORGE T. BARKER.

At a meeting composed of the members of the New York Odontological Society and its invited guests, held January 15th, 1878, to pass resolutions relative to the death of Professor George T. Barker, of Philadelphia, Dr. Benjamin Lord, President of the Society, was, on motion of Dr. J. G. Ambler, made Chairman, and Drs. Francis, Dwinelle, Perry, Ambler and Bronson were appointed a committee; which, on motion of Dr. Wm. Jarvie, Jr., was instructed to prepare and publish a series of resolutions and the minutes of this meeting in the dental journals, and to send a copy thereof to the family of the deceased, and to the Faculty of the Pennsylvania College of Dental Surgery.

E. A. BOGUE, *Secretary.*

The committee, in accordance with the above instructions, present the following:

Whereas, We learn with deep regret and sorrow of the death of our friend and professional brother, Professor George T. Barker, of Philadelphia, in the prime of his manhood and of his usefulness to the dental profession and to humanity; therefore,

Resolved, That we appreciate the upright, conscientious and earnest services of Professor Barker, and remember with feelings of gratitude and admiration his eminent ability, his untiring research, and his candid and generous action in all matters pertaining to the world of professional thought and investigation.

Resolved, That our regret for his untimely decease is lightened by the remembrance that his services to dentistry will ensure that his name and memory shall always occupy an honorable and distinguished place among those of our profession whom we all delight to honor.

Resolved, That our sympathies, true and heart-felt, are hereby tendered to the family, relatives and friends of the deceased in this sad and inscrutable dispensation of Divine Providence.

Resolved, That we tender to the Faculty of the Pennsylvania College of Dental Surgery the expression of our deep sense of the loss they have sustained in the death of him who has so long been associated with their institution and its interests.

CHARLES E. FRANCIS,
WM. H. DWINELLE,
S. G. PERRY, } *Committee.*
J. G. AMBLER,
WM. A. BRONSON,

LIST OF MEMBERS
OF THE
NEW YORK ODONTOLOGICAL SOCIETY,
FOR THE YEAR ENDING DECEMBER, 1877.

The members will confer a favor upon the Corresponding Secretary by notifying him, at once, of any inaccuracies or omissions in this list.

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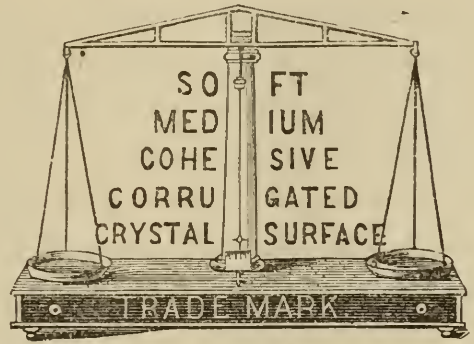
In order to meet the frequent inquiries in regard to different kinds of gold of our manufacture, the following explanations are given. A careful perusal of this and the following pages may clear some point in regard to which you have doubt.

STANDARD

IN FINENESS,



IN QUALITY.

GOLD FOIL.

All gold bearing the above brand is, in the fullest sense, what it is named. It is STANDARD in FINENESS because it is, in every instance, most carefully refined under *our immediate* supervision, and only *chemically pure* agents are used in this process. It is STANDARD in QUALITY because the same care and attention which are used in the refining are continued throughout its manufacture. If any deviation is made from the above, either in regard to purity or quality, the name is correspondingly changed.

In the case of the *untrimmed* foil, which is sold at a lower price, there is the same care in refining, but less work in some of the other processes. The *Cylinder* Foil is refined just the same as the *Standard*, but a *slight* alloy is afterward added.

The greatest part of our own time is devoted to direct personal supervision and work in this department. Many dealers sell gold bearing their names as manufacturers, while in fact they have had nothing to do with its manufacture, and probably could not intelligently perform or supervise any of the different operations; and these are the men who will assure you the most positively that their gold is the best made. If the work could be just as well done by *contract*, we should be foolish to waste our own time.

R. S. WILLIAMS.

STANDARD

Cohesive Gold Foil.

Nos. 3, 4, 5, 6, 10, 20, 30, 40, 60.

This foil is often sufficiently cohesive without heating; but if from long keeping or other cause it has lost this quality, re-annealing will make it reliably cohesive, *except* in cases where it has been exposed to influences which may not be wholly removed by heat.

Annealing should be done judiciously. With thin numbers, as 3, 4, 5 and 6, used as pellets, it is not always necessary to heat to redness, as this causes it to ball up and rock from its first position, while a lower heat will usually give sufficient cohesiveness and less harshness. A few trials, beginning with a low heat, will indicate what degree is needed. If the foil is folded smoothly, or a thick number is used in single thicknesses, a higher heat can be used to advantage.

When gold is to be used strictly cohesively, as for contours or surfaces, it is only justice to the manufacturer to use what is labeled or known to be cohesive.

R. S. WILLIAMS.

STANDARD

Medium Gold Foil.

Nos. 4, 5 and 6.

When freshly made, and used without annealing, this foil has a very soft feeling and yet seems cohesive under pressure. It is important to have this fresh, because it is very susceptible to changes. If necessary to anneal, use a very low heat, particularly if it is intended to preserve the *medium* quality; a high heat will make it nearly the same as the cohesive.

R. S. WILLIAMS.

STANDARD

Soft Gold Foil.

Nos. 4, 5 and 6.

The peculiarity of the above is, that while no alloy is used, and it is as pure as the cohesive, yet it is sent out in such a condition that the surfaces will readily slide on each other, working soft under the instrument, and only consolidating under heavy pressure. If used strictly as a soft foil, very little heat should be used; if annealing is needed, a slight *warming* is generally all that is required. A higher heat will make it considerably cohesive.

If a person wishes to use only one kind of foil for all cases, we should recommend this as the best we could make; yet it has been our practice, for some time past, to recommend for *surfaces and contours, gold which is regularly cohesive.*

R. S. WILLIAMS.

STANDARD

CARBONIZED GOLD FOIL.

Nos. 4, 5 and 6.

Pat. Jan. 25th, 1876.

This is *soft, waxy,* and, if annealed, moderately cohesive, without becoming stiff.

It is a soft foil without any alloy, but has a *slight* deposit of pure carbon on the surface, to prevent too rapid cohesion.

As carbon is a pure substance, and subject to no change in the mouth, there seems to be no possible objection to its use.

One property is worth mentioning. If a piece of this foil is rolled up into a ball or pellet and annealed, the carbon inside will be scarcely changed at all, while on the surface it will be partially consumed by contact with the heat of the flame and the oxygen of the air. Of course this gives a greater degree of softness inside, and a greater degree of cohesiveness outside—a combination which is often desirable.

R. S. WILLIAMS.

STANDARD

Corrugated Gold Foil.

Nos. 4, 5 and 6.

This has a peculiarly beautiful, roughened surface. From the process of manufacture it is very soft, and, when annealed, cohesive enough for all except extreme cases.

It will generally stand for surfaces and contours, but it is liable to wear rough, and is not recommended for these uses. For rapid and efficient use inside of cavities it is admirable.

Annealing to redness does not injure its working qualities so much as is the case with other kinds—it does not readily stiffen.

R. S. WILLIAMS.

STANDARD

CRYSTAL SURFACE GOLD FOIL.

Rolled (Cohesive). Nos. 30, 40, 60 and 120.

Pat. June 21st, 1870.

This is rolled only, not beaten. After the rolling is completed, the whole outside surface is dissolved off with Aqua Regia, this giving what is found in no other gold—an absolutely clean and pure surface. The process of dissolving leaves the surface slightly irregular, and discloses the crystalline structure of the gold—hence its name. This peculiar surface and its purity give it a remarkable cohesiveness. As this is generally used either in single thicknesses or folded flat, there is no objection to annealing to a *full red* heat, or to any point short of the melting point.

For *contours, surfaces, cases where great strength or cohesiveness* are required, we recommend this more highly than any other gold.

R. S. WILLIAMS.

Dental and Oral Science Magazine

No. 2. MAY, 1878. Vol. 1.

New York Odontological Society.

Regular Meeting, January 15th, 1878.

The meeting was called to order at 8 o'clock P. M., Dr. Benjamin Lord, President, in the chair. The Librarian read the following report of a case from Dr. W. W. Johnson, of Boston.

"Miss S———, now in her 22d year. First saw this patient October 16th, 1875. Right lower second bicuspid had at that time lately erupted. Saw her again April, 1876. Left lower second bicuspid was then just coming through the gum, but one cusp being in sight. May 19th, 1877, left bicuspid fully erupted, as shown in the cast of the lower set, sent herewith, and which I made at this sitting. Did not see her again until December 22d, 1877, when I made the cast of upper set, which I send herewith. She tells me the teeth which are missing were extracted some eight or ten years ago, and does not know or remember how many or what teeth they were. She has lost no teeth since I first saw the case, although she came to me on her first visit for that purpose. A fullness just back of the superior lateral incisor indicates where the missing canine lies unerupted."

A letter from Dr. Thornton, of Providence, R. I., was then read, and an artificial piece, on aluminium base, which accompanied it, was exhibited.

DISCUSSION.

Dr. N. W. Kingsley (*New York*): I do not think there are many advantages to be gained from the use of this metal as a base, while it labors under certain disadvantages.

Dr. A. H. Brockway (*Brooklyn*): I believe that set of teeth was in my hands about two months ago, but there was then no opportunity to present it before the Society. I showed it to Dr. Rees, of Williamsburgh, and learned from him that, although he had spent much time in experimenting with the material, he could produce no satisfactory results. The work, when done, appeared well, but wore very badly. Dr. Rees showed me an aluminium plate which had been worn some years. This plate was literally honey-combed. Dr. Rees stated that this peculiar changeability seemed to be the great defect of the material, and that he had, in consequence, abandoned it.

Dr. Wm. Jarvie, Jr. (*Brooklyn*): I have never had personal experience of this metal, but understand that a great heat is required to melt it.

Dr. Brockway: That is a swedged plate.

Dr. Jarvie: I understand that it requires much harder metals for the cast and die than gold.

Dr. J. B. Rich (*New York*): The principal objection to its use is its want of durability. A very high heat is not needed to melt it; but in casting a great pressure is required. I should think that, as to durability and stiffness, it would not bear comparison with gold.

Dr. E. G. Roy (*New York*): Would it be attacked by the fluids of the mouth?

Dr. Rich: I think it would. It is oxidized very easily, even through the touch in handling. It is very light, its specific gravity being only 2.6; but it seems to have little durability in the mouth.

Dr. St. George Elliott (*New York*): The difficulty with this material is, that the oral fluids attack it readily. As you all know, Dr. Bean, of Baltimore, introduced the cast aluminium base. Dr. Essig, of Philadelphia, told me he had experimented with Dr. Bean, and that much had been expected from the material; but that it had failed utterly in practice, by reason of alkaline reaction.

Dr. Jarvie: Is not Dr. Rich mistaken as to the pressure required in casting aluminium? I have seen a plate of it cast, when no pressure was used. The metal was simply poured while the cast was at a white heat.

Dr. Rich: It certainly can be so cast; but, unless under pressure, it will be very porous, and will not take a polish.

Dr. E. A. Bogue (*New York*): About eleven months ago a lady went to one of our dentists, complaining that the left central incisor was becoming discolored, and that she thought the pulp was dead. The dentist drilled the tooth, removed the pulp, and filled the root with gold. After a few months the tooth began to grow black, the color being decided at the margin of the gum, and lessening in intensity toward the centre of the tooth. Three or four weeks ago the same dentist removed the filling, but refilled the root through a cavity drilled into the lingual side of the tooth. To the crown he applied (as he tells me) chloride of lime, in order to bleach it. This proved unsuccessful, and he then had recourse to chalk and carbolic acid. In eight or ten days thereafter the tooth became perfectly black. The case then passed into the hands of three or four other dentists, and reached me last week.

The President: Did you find the tooth decayed?

Dr. Bogue: Not at all.

Dr. Brockway: When was the tooth first filled?

Dr. Bogue: Eleven years ago.

The President: Was there any suppuration?

Dr. Bogue: No; there never has been.

Dr. Jarvie: Can Dr. Bogue tell us what was the condition of the first filling, when removed? Was the root-filling perfect?

Dr. Bogue: I never saw the tooth before a week ago.

The President: Did you remove the second filling?

Dr. Bogue: I drilled out about half the filling, which seemed sound. I think the first filling may have been defective. But, considering those agents which the dentist applied to the tooth, I cannot see any cause for its blackness.

Dr. Jarvie: When you removed the filling, did the discoloration affect only the surface of the cavity, or did it seem to permeate the tooth?

Dr. Bogue: All the dentine was affected, and that to a degree worse than I ever saw before.

Dr. S. G. Perry (*New York*): Did you try oxalic acid?

Dr. Bogue: Yes, sir; thoroughly. I three-quarters filled the cavity with crystals, and allowed water to dissolve all that it would.

Dr. W. H. Dwinelle (*New York*): The question of moment here is, What is the coloring matter now in that tooth? It generally comes from decomposition of the blood. Oftentimes teeth are discolored by improper treatment in bleaching; some agent is presented which acts as a mordant, and the color instantly appears, upon the principle involved in the dye and mordant. I have sometimes found, during the use of chloride of lime, that such action seemed to ensue; but I have generally succeeded, finally, by continuing the operation. I feel justified in speaking somewhat boldly on this subject: for I introduced the system of bleaching teeth to the profession more than thirty years ago, and have had considerable experience in the matter since. Chemistry tells us that oxalic acid is one of the best solvents for iron. I have from the first found it one of the most successful agents in bleaching teeth; after applying it to the teeth it should be thoroughly washed out of the cavity before applying other agents. Hence it came that, years ago, I suggested the decomposed blood as the source of dental discoloration by being injected into the tubuli of the dentine. The blood is decomposed under inflammatory pressure. Suppuration is, in this regard, only another name for separation of the components of the blood. Except through such separation and breaking down of the blood corpuscles its coloring matter, which is iron, could never enter the dentinal tubuli, for they are smaller in diameter than the blood corpuscles. I have often found dead teeth becoming discolored through leakage down the pulp canal, until the material reached those tubuli which ramify from the canal at angles greater than 45 degrees (as they do toward the crown). This fact has given me great trouble. I have, in such cases, removed the root-filling and refilled very carefully up to the chamber, which I have then altered in shape so that the base of the cone formed by it shall be toward the root, not the crown. I think the leak is generally through or around the root-filling. It is excessively difficult to prevent such leaks. I have had the best success by filling the root with gutta-percha, which I carried around the sides to the borders of the crown cavity, then filling the cavity proper with gold. As to the cause of the blackness of this tooth, after it was partially bleached, the only theory I can offer is, that, in some way, the mordant and dye were brought together in the process of bleaching. If the root was perfectly filled, I should say there had been no leakage; but that cannot be certified here. Chloride of lime is one of our best bleaching agents. I generally use it wet; at other times I use it comparatively dry. There are other forms of chlorine which can be used with great advantage. Chloride of sodium is oftentimes an excellent bleaching agent.

Dr. Rich: The history of the case, as given, is not such as to form a correct idea of its cause. We do not know the condition of the first filling when removed. The exciting cause, as I see it, must have been imperfect root-filling, and subsequent leakage. Chloride of soda must be used dry. Water discharges the chlorine before you can get it to the tooth. If it is applied dry, and sealed up immediately, there is sufficient moisture in the tooth to free the chlorine for action. I have succeeded thus when no other method of bleaching produced any effect. I leave it in the tooth for various periods, sometimes changing it every day. If it is mixed with dry cotton, so that it may be packed in the cavity, it will be seen, upon removal, to have become dark on its surface.

Dr. Bogue: Can Dr. Rich state what combination would be produced by the use of any chlorinated substance followed by carbolic acid and chalk?

Dr. Rich: That question cannot be answered except by the aid of accurate analysis of the tooth itself. The constituents of dentine vary in quantity, and a very slight change in circumstances might produce a great variation in results.

Dr. Bogue: Years ago I applied to Dr. Dwinelle to discover what he would do in a case of discoloration. He answered me, "Find out what has discolored the tooth, and then apply the proper agents to remove that discoloration." In this case I inferred what the gentlemen present seem to have inferred—that the first filling was defective, and that remnants of the pulp, in both chamber and canal, existed. In fact, I found such remnants in the pulp chamber, and removed them as far as I was able to do so. I reasoned that whatever had discolored the tooth must have acted from the inside outward, and I made my applications to act in that direction. I knew that if hæmatine was the discoloring agent, chlorine would be worthless; for chlorine does not attack iron. I isolated the tooth, and washed with water, and then with ammonia; for I knew that if I used acid first, following with ammonia, I should then be at the end of my possibilities. The ammonia turned the tooth red. I then filled with dry chalk, and sent the patient home. Two days afterward the tooth was nearly as dark as before. I again isolated the tooth, and filled it with crystals of oxalic acid, adding water in due proportion. In fifteen or twenty minutes I dried the tooth with a warmed instrument and hot air syringes applied internally. It then appeared as white as its neighbors. However, it did not remain so, and becoming convinced that I could not bleach it, I filled it with chloride of zinc, using the whitest specimen I could find. As for using chloride of zinc for bleaching teeth stained with iron compounds, I do not feel like doing so. I once attempted this process, under such circumstances, with chloride of lime, and got as a result a yellow and checked tooth. I should have known better.

Dr. Rich: Why do you say you should have known better?

Dr. Bogue: In a tooth discolored by iron, I should have known better than to have used chlorine.

The following paper was then read by the author:

MECHANISM OF SPEECH.—Second Paper.

BY NORMAN W. KINGSLEY, D.D.S.

My paper, read before the Odontological Society at its special meeting in November last, upon the Mechanism of Speech, closed with descriptions and illustrations of the positions of the organs of speech in the formation of nearly every sound of the English language, so far as they come under a general law, and are capable of illustration by diagram.

As there has been some difference of opinion among observers in regard to this matter, I will describe the means which I employed to verify the statements of that paper.

My attention was first directed practically to this subject through the necessity of my giving certain of my patients directions how to make the best use of an artificial organ of speech.

Discovering, in the very beginning of my treatment of cleft palate, that in all congenital cases the speech of the patient was improved but little, if any, immediately upon the introduction of an artificial palate, and that speech, being a mechanical and acquired function, instead of a natural function, like respiration or digestion, must be learned by the use of organs—natural or artificial—properly adapted to produce, with practice, such a result, I was accustomed to recommend my patients to employ an elocutionist to aid them in their efforts.

My desire and expectation was that these professors would teach them *articulation*. But the experience of several years with various teachers was, that my patients were not taught articulation systematically or scientifically, and that improvement in speech resulted more from practice in the presence of an intelligent critic of results, rather than from positive directions how to place the organs to produce a given sound.

Thus it came that the difference of improvement among various patients was sometimes very great. Some seemed to fall very rapidly into the ability to make articulate sounds, while others went blundering along for months and years without complete success. The experience with teachers of elocution was found to be of no more value than the same practice in the presence of a non-professional critic.

Believing that articulation could and ought to be taught scientifically, and hearing, some fifteen years ago, that success had been met with in teaching deaf-mutes to articulate, I visited Dr. Peet, who was at the head of the Asylum for Deaf and Dumb at Washington Heights. He discouraged the idea, and said that the experiment had been tried in Germany, and somewhat in this country, but with no results of any value.

As the years went on and the number of cases of cleft palate increased, I became more observant of the action of the organs of speech in normal people. To this end I had abundant opportunities among the patients sitting in my chair awaiting other operations.

My observations led me to doubt if the laws which governed articulation were not so subtle that I could not comprehend them.

Identical sounds, so far as my ear could detect, were constantly produced before my eyes by different persons, with organs in seemingly different positions, and all my investigations seemed hopeless of result until the discovery was made, as described in my last paper, that articulation, or the formation of vowel sounds, was due, not to placing the accessory organs of speech uniformly in a definite position, but to the formation by those organs of a cavity of certain dimensions with a certain and uniform resonating power. The variation in the positions of the articulating organs, as seen in different persons in producing the same sound, was then understood.

In the production of articulate sounds by different people, there are certain nice distinctions of pitch, timbre and tone which it is not the province of this paper to enter into; but of the distinct sounds of the English language, appreciable to nearly all ears, and represented by characters or letters, the difference is sufficiently marked, and the mechanism of their formation is sufficiently positive and pronounced, that we are able to discover it, to describe it and to illustrate it.

The means which I adopted were as follows: I made a cast of the roof of my own mouth, extending back and down to the boundary of the fauces, and upon this cast I fitted a very thin and delicate plate of black vulcanite, covering the entire roof within the teeth and the palate.

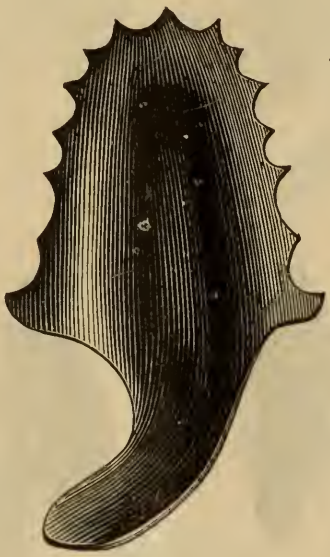


FIG. 1.

Two or three such plates were made, duplicates of each other in the roof of the mouth, but varying in the palatine portion. One of these plates is shown in Fig. 1. In this one the sides of the posterior or palatine portion have been cut away, leaving a tongue extending down to the uvula; one of the others covered the whole palate, and in another the entire palatine portion was cut away. When used to test articulation, one of them was painted with a film of chalk, wet up with alcohol so that it would dry quickly, and then introduced into the mouth, and the sound experimented upon made clearly and distinctly as possible, and the plate removed. If the tongue touched the roof of the mouth, the teeth or the palate, in any part, the white surface of chalk was removed, exposing with the utmost distinctness the black surface of contact. The form of the contact in a given sound was delineated upon a clean plaster cast of the roof of the mouth standing by, and the experiment repeated with the same or some other sound.

These experiments were repeated over and over again with the same sounds at different times and on different days, until uniformity was proven, and the various plaster casts became a record of the exact position of the tongue in making these sounds.

Drawings of those plaster casts are here presented, and the interested reader will derive more benefit, probably, by a comparison of them with the diagrams which appeared in the last number of this magazine.

The explanations will follow the order of that paper, beginning with the vowels and continuing with the consonants.

In making the sound of OO as shown by the former diagram, the tongue is much depressed at its tip, in the floor of the mouth, and lifted very high at the back, toward the soft palate. My experiment with the chalked plate showed that in making this sound the tongue did not touch the roof of the mouth at any point. The same result followed the enunciation of O and still farther from the roof was the tongue along its entire length when making the sound of AH.

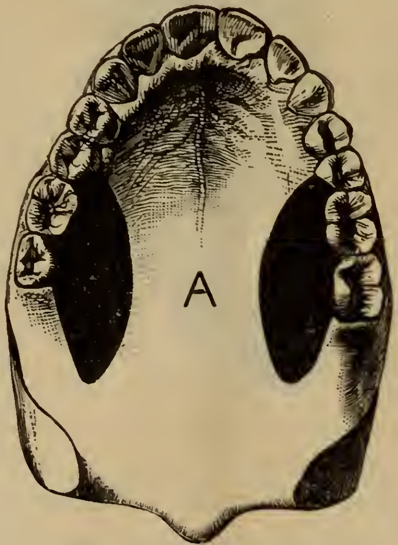


FIG. 2.

But there was a marked change when A was produced. At each articulation of this vowel the tongue rose until it came in contact with the alveolar border against the molar teeth—wiped off the surface of chalk, and exposed the black vulcanite, as seen in Fig. 2.

The curve of the upper surface of the tongue in this sound was nearly parallel with the roof of the mouth, making a tube of somewhat uniform size, when they were in contact, as represented in Fig. 2. In making E, Fig. 3, the tongue rises still higher, and makes a still narrower channel or tube through which the sound passes.

While observing Fig. 3, the reader will notice that SH and ZH are both marked on the same cast.

In my experiments I was not able to detect any marked variation in the position of the tongue in making E and ZH. The change from E to ZH seems to depend more upon a change of position of the lower teeth and lips, than upon a different position of the tongue. SH is also included in this illustration, as its production, mechanically, is identical with ZH, and differs, as before stated, in being a breath sound, while ZH is vocalized.

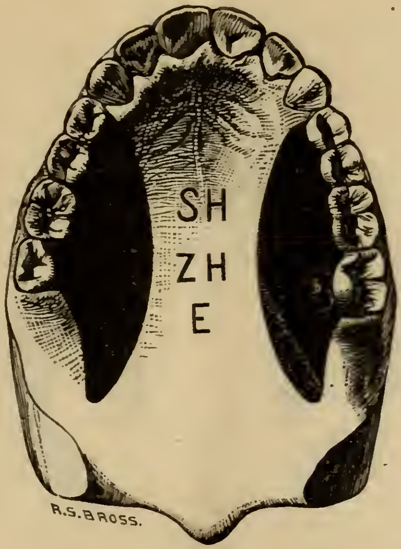


FIG. 3.

With P, B and M the tongue does not necessarily come in contact with the roof of the mouth in their enunciation. The mechanism of their production is confined to the lips, and any contact of the tongue with the roof at the time is only incidental, and dependent upon the

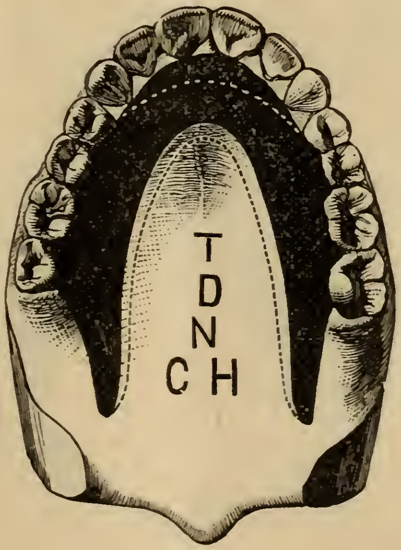


FIG. 4.

vowel sound with which either of these consonants is joined. Thus, in the syllable OP or OB, there would be no contact; but with EP or EB there would be the same contact as seen in Fig. 3.

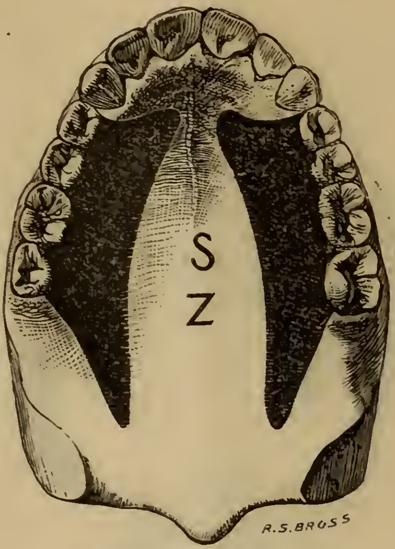


Fig. 5.

In the production of the dentals this contact becomes very marked, as is seen in Fig. 4, the tongue pressing against the alveolar ridge throughout its length. In the articulation of T and D the contact was shown to be identical; but in making N more of the black surface was

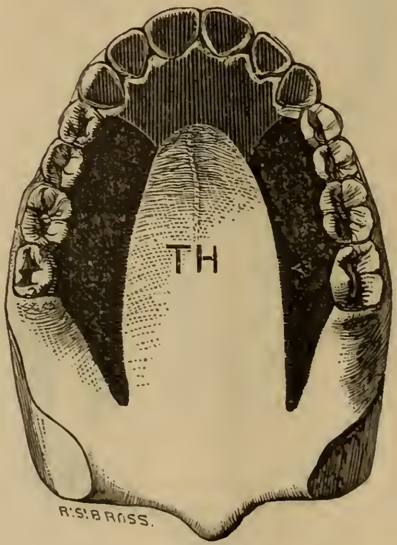


Fig. 6.

exposed than in either T or D. The general appearance was the same; but the exposed surface was broader, as indicated by the *black* dotted line in Fig. 4.

I accounted for this by the belief that in sounding N the tongue is held against the roof of the mouth for a longer period ordinarily than with T or D, and thus contact became more general. So far, then, as the tongue is concerned, there is no essential difference between the three.

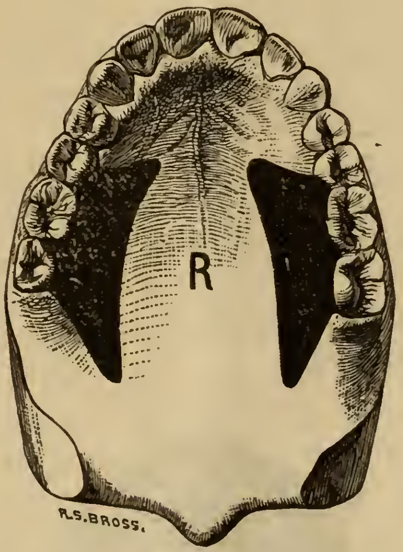


Fig. 7.

CH (*both* dotted lines in Fig. 4), which, by some, has been said to be a combination of TSH, and not a distinct sound, I found to produce a different exposure from either T or TSH, on every articulation and at every experiment. The contact of CH is farther back from the teeth and higher up toward the roof of the mouth than either of the other sounds

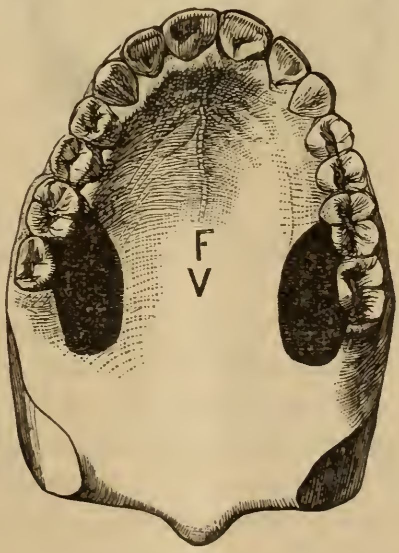


Fig. 8.

(see *white* dotted line); and with me the distinction was so marked, that I cannnot regard TSH as an equivalent for CH.

With S and Z, Fig. 5, the channel for escaping sound is very narrow at the tip of the tongue, and is less than with any other letters, unless it be TH. In producing TH, Fig. 6, the tongue is close in contact at the sides, but lightly in contact with the front teeth and the alveolar border immediately behind the front teeth, the aperture for the escape of sound being broad, but very slight.

R, Fig. 7, shows contact at the sides, behind the centre of the mouth, with space at tip of the tongue in the roof, the characteristic sound being made by rapid vibrations of the tip.

In making F and V, Fig. 8, the contact is like A in Fig. 2, only much less, being confined to a part of the molars and a limited portion of the adjacent alveolar border.

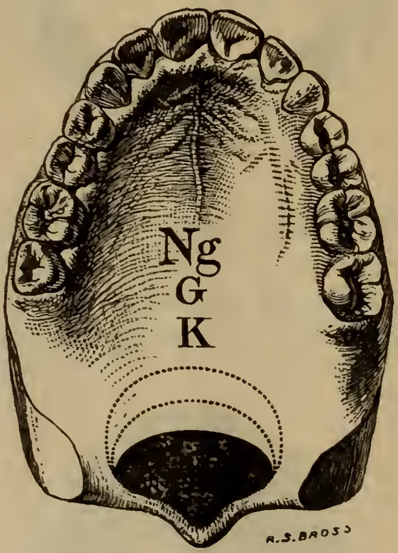


FIG. 9.

In Fig. 9 we have a very marked demonstration of the mechanism of K, G and NG.

These sounds are not produced, like many others, with the soft palate considerably elevated. For example, in producing the vowel AH, the *velum-palati* is lifted to its highest capacity, and in some cases so much as to form a dome behind the hard palate, thus creating an actual double dome in the roof of the mouth; but in K, G and NG, the posterior border of the soft palate is but partially elevated, and is held tense in that position while the tongue backs up against it.

The contact of K is represented by the black surface in Fig. 9; G, by the middle dotted line, representing the outer border of contact, while in NG the tongue covered the whole soft palate, from the uvula to the outer dotted line. Both G and NG could be made with contact as limited as that of K; but every natural effort in making them showed a larger surface. It will be remembered that the distinction between these sounds lies in K being an explosion of breath sound, made by a sudden relaxation of tongue and palate—the posterior nares being at the same time closed. G is vocal sound made in the same way. In NG the tongue and palate are *not* relaxed, but the nares are opened, and vocal sound escaping through the nostrils produces NG. This opening and closing of the posterior nares is due entirely to the contraction of the *superior pharyngeal constrictor*, while the closing of the nasal cavity, in the formation of vowel sounds, is accomplished by the soft palate alone.

These experiments were of the greatest value to me in determining for myself some points which I never could have known, with certainty, in any other way. For example, I had long felt that the superior constrictor muscle of the pharynx was a very important organ of articulation; but the belief was without positive proof. I was led to such belief by seeing its action in abnormal or cleft palate cases, but, as in a normal condition it could not be seen, it remained a theory with me until I demonstrated it upon myself beyond a peradventure. Its action was particularly distinct in the production of the sounds of G and K. My experiments upon these sounds consisted in taking the plate, Fig. 1, and altering the inclination of the palatine projection until it exactly met the point of contact of the soft palate and tongue in the production of these sounds. The experiment was tried repeatedly, until there was no possibility in my mind of mistake. These two sounds were made naturally and with entire ease, the end of the plate being in contact with both palate and tongue. Now these sounds could not have been made unless at that instant the passage from the pharynx to the nasal cavity was closed—under the circumstances there was but one method of closure, and that by the advancement of the pharyngeal wall. But I was still further convinced, by finding that with the cessation of the effort to make the sound, respiration through the nares was free and unobstructed—the plate retaining the same position of contact with the palate and dorsum of the tongue. Furthermore, the plate, thus showing the true inclination of the palate in the production of K and G, was introduced, and the vowel AH pronounced before a glass, and it resulted in the lifting of the posterior palate far away from the plate, thus showing that in the vowel sound of AH, the palate is carried high up and back against the pharyngeal wall, thus closing the posterior nares, while in the production of K and G the palate is depressed and the posterior nares is closed by the advancement of the pharyngeal wall, through contraction of the superior constrictor.

I had seen this action often in cleft palate cases, but did not know but it was an unnatural development, due to abnormal condition of the palate. In one instance which came under my observation this contraction of the pharyngeal wall set at naught all opinions theretofore maintained, viz.: that a congenital cleft palate was fatal to any effort to pronounce K or G.

This patient was a man some 35 years of age, with almost entire absence of the soft palate—the roof of the mouth gone—alveolar ridge—incisor teeth—and inter-maxillary bone—and originally a double hare-lip. His speech was so bad that in giving him a passage to read before an audience not a word of all he read was understood by his hearers, and yet this man could pronounce the sounds of K and G with the utmost clearness and distinctness, not to be misapprehended or misunderstood. The phenomenon was a mystery to me until, in my further experiments with him, I discovered that he brought the dorsum of the tongue and the advanced pharyngeal wall into contact.

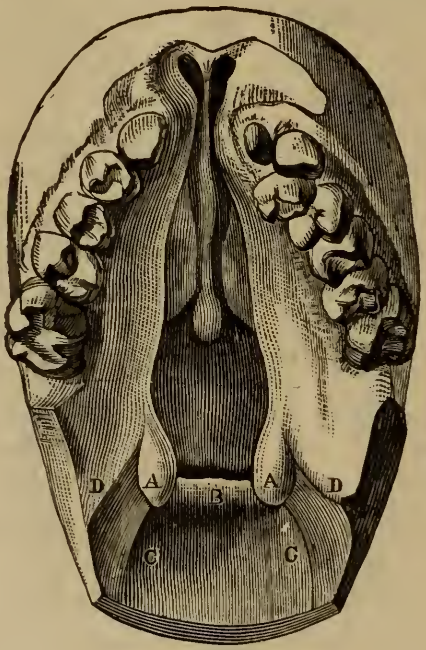


FIG. 10.

In fact, he had done but little more than all of us with normal organs are doing constantly. I doubt if the dorsum of the tongue and the pharyngeal wall are separated from each other more than the tenth of an inch* at the time of making these gutturals by any of us with well-formed organs. So that the closure of that little space by that man was not so very surprising. But this same patient reversed all the usual manifestations of cleft palate cases.

Figure 10 represents a model of the mouth referred to. AA shows the bifurcated uvula at the extremity of the remnants of the soft palate which is here shown as drawn up under the action of the *levatores-palati.*

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* See Fig. 9, page 57, of No. 1., DEN. & ORAL SCI. MAG.

B., the superior pharyngeal constrictor, drawn forward and in contact with the uvulæ. CC shows the palato-pharyngeal muscles, the borders of the pharynx, and DD the palato-glossus. The vomer and turbinated bones are seen exposed in the anterior part of the nasal cavity.

Ordinarily I find it impossible for cleft palate patients to pronounce G or K, but they have no difficulty with T or D. In most cases T is quite perfect and D is defective only in tone, but not in distinctness of utterance; but with the man above referred to, T and D, S, Z, CH, SH, ZH, etc., were absolutely impossible, as the necessary obstruction to the tongue in the formation of these sounds was wanting.

Such experiments as I have described and a knowledge of the mechanism of speech are of incalculable value to one who is called upon to remedy defects of the organs of speech.

They have been of great importance to me in the diagnosis of cleft palate. The reading of a single sentence by the patient will enable me to form an opinion of the exact difficulties to be overcome, which are rarely the same in two cases. Patients with congenital cleft are making a constant effort to overcome their difficulty by trying to make the, to them, impossible sounds. The result is the tongue and associate organs acquire habits of position which often have to be broken up if they undertake to articulate with an artificial organ. These bad habits are as various as the individuals, but a critical ear can detect their effects and refer them to the cause.

I find contracted habits of this character sometimes, which will be of great value to preserve with a certain kind of instrument applied ; while with another form of instrument such habits would prove detrimental. But while this knowledge of the mechanism of speech is of importance in determining the kind of instrument to apply, it is of equal and even more value to the patient to whom the instrument is adapted, in suggesting and directing them how to make the best use of it.

Finding that my patients derived so little benefit, generally, from professors of elocution, it has been my practice latterly, after an instrument has been introduced, to give them a few sittings and drill them upon their most defective sounds. The progress sometimes under an hour's drilling is marvelous. I have seen patients rise at the end of an hour with gratitude beyond expression at the discovery of an ability to articulate words which have been a source of life-long mortification. The training has been adapted to each case, but in the main has been an endeavor to lead them from some sound which they make with tolerable perfection to the defective one which is most nearly allied to it physiologically. For example, I had introduced an artificial palate for a very intelligent lady of something over 30 years of age, but whose speech was exceedingly bad ; I wrote on a slip of paper the words GO, KO, SO, NO, DO, TO, HO, and repeated them on the slip several times promiscuously, and handed to her to pronounce aloud as distinctly as possible. Of the whole, HO, NO and TO were good, showing that H, N and T were correct. Of the others DO was like TO, and all the others were pronounced exactly as if written NO. I repeated the experiment over and over again, and there was no possible distinction between GO, KO, SO, and NO—they were all alike—NO.

I began to drill her on S, explaining its hissing sound, trying for half an hour to get her to "hiss" through the tip of her tongue. But with all my explanations she failed to place the tip of the tongue in the only position where S could be made.

I then made her sound the H and T, which were good, and combine them in HAT and repeat the word after me distinctly and rapidly as possible. After some moments of rapid utterance, and she had obtained free command of herself, I changed suddenly from HAT to HATS, and she, to her own great surprise, pronounced the S distinctly. The explanation, as the reader will easily see, being that the physiological change from T to S is so slight that with her rapidity of utterance she had not time to change the position of the tongue and make S in her own defective way, and she made it correctly by mistake ; but it was the steppingstone which led on to perfection.

Another very interesting case came under my observation. A father brought his son to me—a young man of mature years—who had fissure of the soft palate only. I was not favorably impressed with the intellectual development of the young man. He seemed stupid and had but little realization of his own condition. His speech was very bad—much worse than most cases where the fissure is no larger than his. His reading was a monotonous, half-idiotic sound, with but little marking off of vowels, consonants, syllables or words. After two or three interviews I came to the conclusion that it would be hopeless to expect any improvement from him in the use of an artificial palate, and I frankly told the father that I could not encourage the undertaking. Upon being urged for reasons, I stated them as delicately as possible, as being based on what seemed to me to be defective mental power. But such an intimation was not to be listened to by the "fond parent," and he saw no reason why "his boy" shouldn't have an artificial palate as well as any one else, as he was ready to pay for it. After a complete understanding by them of what would be necessary for him to do for himself after my work was done, I made and adjusted the appliance. Within the same hour after its introduction I sat him before me and directed him to imitate exactly every motion of my lips and every sound of my voice. After a half hour's training he enunciated every sound of the English language with all the distinctness and precision of one with well-formed organs.

This he would do under my dictation, executing my will almost as if he had no will of his own—not only sounds, but words and sentences were repeated with clearness and distinctness, and I began to repent the discouragement I had given them.

But passing from my dictation he dropped into his former habit of monotonous indistinctness, and I became less hopeful of ultimate results.

Regular Meeting, February 19th, 1878.

The meeting was called to order at eight o'clock, P. M., the President in the chair.

Upon "Incidents of Office Practice" being called in the order of business—

Dr. Bogue: At the last meeting I referred to a case of bleaching, which had puzzled me very much. I wish to state that I now regard the case as almost a complete failure. I could get a fair light color to remain for two or three days, which, however, invariably gave place to a disagreeable brown, in which condition the tooth now remains.

Dr. C. A. Woodward (*New York*): I have a case of irregularity which I wish to bring to the attention of the Society. I would also ask if it is practicable to shorten teeth by forcing them further into their sockets, and, if it is so, how far they can be so moved without endangering the pulps? The case in question is as follows: About six months ago I was engaged in elongating a lateral incisor. While the patient was in the country she bent one of the clasps which I had put over the tooth in such a way as to cause it to press upon the crown. The tooth receded in its socket so much that it became at least a thirty-second of an inch shorter than its fellows. This shortening occurred in about four days' time; but, upon removing the pressure, the tooth returned to its original position in two days. No injury has occurred from this, as far as I know. The pulp is alive. The occurrence gave me the idea that the process might be applied, where needed, as one of the ordinary methods of regulating.

Dr. A. C. Hawes (*New York*): I had a somewhat similar experience about a year ago. While trying to force back some too prominent teeth, one of them, a central incisor, became, from some cause which I do not know, considerably elongated. At that time I was using a little band about the front teeth. I simply attached a loop to the band, so that a steady upward pressure was brought upon the elongated tooth. In about two days it returned to its original position, at which it now remains. No other disturbance was experienced. I have not, however, endeavored to shorten teeth by such means, and should suppose it would be very difficult.

Dr. Shannon (*Brooklyn*): I had, last week, an interesting case of bleaching. The tooth was a right superior lateral, and had been filled with gold to the apex of the root, many years ago, by Dr. Garrett, of Delaware. It did very well until recently, when, the patient being in a condition of depressed vitality, it began to trouble her. She went to a dentist, who removed the filling from the crown and endeavored to open the root; but, in doing so, he drove his drill through its side. I think he must have known it, yet he did not advise the patient of the occurrence. There was free bleeding, as she stated. The operator filled the tooth with Hill's stopping. The patient passed a sleepless night, and then came to me. Upon removing the gutta percha, I discovered the hole in the side of the root, with the gold still remaining in the apicial portion, and considerable periostitis. The tooth was quite dark colored, and had been so for some years. After quieting the bleeding, I took a piece of linen and some oxychloride of zinc, and covered the side opening in the root. Then, by slow process, I removed the remainder of the gold. The next day there was a fistulous opening in the gum. The piece of linen and the oxychloride covering the side opening were in place and operating well. I injected creosote thoroughly through the root. On Thursday or Friday last I treated the tooth with oxalic acid, and obtained immediate good results. I give this incident in view of Dr. Bogue's remarks regarding the action of oxalic acid on the tooth. I packed the root and side depression with creosote in cotton, and subsequently filled with Hill's stopping. The color of the tooth is now much improved, and the case is doing well.

Dr. Mills: In a case which came under my observation, an operator had endeavored to set a pivot tooth in a cuspid root, the tooth having been broken. There was a hole on the side of the root above the soft parts, and the pivot had taken the line of this hole and been forced out through it. Of course the parts became much inflamed, and all efforts to give relief were ineffectual. The result was the extraction of the tooth and the finding of the pivot sticking through the side of the root.

Dr. S. G. Perry: I had a case of a second molar, a mere shell, in which a large cavity on the posterior surface extended under the gum, and there was great difficulty in applying the rubber dam. I laid a large mat of tin foil at the bottom, and filled the cavity about three-quarters full with tin; leaving the tooth in such form that there was still left a distinct cavity, in which I packed gold. The contour was restored so that it met that of the adjoining tooth. It would have been almost impossible to so place the dam at first as to get in a complete gold filling. The appearance of the tooth was that of an ordinary gold filling, no tin being in sight.

Dr. C. S. Stockton (*Newark, N. J.*): A gentleman came into my office with a left upper second bicuspid, a sound tooth, split through the centre. He did not want to lose the tooth. I took an impression, temporarily secured the tooth with fine wire, and then fitted a platinum band accurately around the tooth. I also ground off the cusp of the lower tooth. The patient has had no trouble since the occluding cusp below was removed. I am apprehensive that the pulp will die; although it was alive yesterday when I put the band on.

Some time ago a lady, forty years old, came to me, who had never had her teeth operated upon in any way. The two right lower bicuspids had ulcerated several times for years, and the face had swollen, although there had never been a fistulous opening. I treated one tooth with aromatic sulphuric acid, and the other with creosote and carbolic acid. One application of the acid sufficed. Its tooth was cured. I filled the tooth with gold two weeks afterward, and there has not been any difficulty with it since that time. The other tooth has been a dozen times treated with creosote and carbolic acid, and is still sore.

The President: May there not have been a difference of condition between those teeth?

Dr. Stockton: None that I could discover.

The President: Did you open up through the foramen?

Dr. Stockton: I did not. There was no peridontitis in either case. The question with me, is why did one tooth get well and the other remain sore?

The President: Do you know whether, in either case, any of the application passed through the foramen?

Dr. Stockton: I think it did. It was my purpose to pass it through in both cases. The patient felt pain, and I suppose the applications passed through. There was no fistula.

Dr. C. P. Fitch (*New York*): A year ago last summer a lady called upon me having a superior second sound molar with its palatine root so denuded that there was an exposure of the pulp at the apicial foramen. Several dentists, whom the lady had previously consulted, decided that the tooth must be extracted. At first I was of the same opinion; but after a moment's reflection I decided upon another course, experimental in its character, looking to the preservation of the tooth. I introduced a small saw between the roots, and, cutting the denuded root from the body of the tooth, extracted it. I applied creosote to the exposed pulp, and dismissed the patient. The next day she returned, suffering some pain. I removed the cotton which I had gently pressed into the canal leading to the pulp chamber, and she was relieved. I dismissed the patient after sealing the opening with Hill's stopping. Yesterday she called upon me and I found the tooth in excellent condition, the two labial roots doing good service.

Another case surprised me very much at the time. Four months ago a gentleman entered my office to have an inferior molar—second or wisdom, I forget which—extracted. The tooth was very loose, so that I could easily work it backward and forward, the alveolus having been absorbed, nearly, if not quite, to the points of the roots. I applied the forceps with gentle force, but unexpectedly experienced much resistance. The tooth, acting like the piston of an air pump, and drawing the contiguous soft structures after it, came away, after a little, with a snap, the patient experiencing great pain upon the side and under the jaw and at the roots of the tongue. Upon examination I discovered a white fibrous body protruding from the place from which the tooth had been extracted. It yielded a little by pressing it down into the socket, but returned quickly on the removal of the force. This was attended with acute pain. At first I thought it was a cyst, but finding no such indications from examining the tooth, I quickly came to the conclusion, as there was much swelling and soreness under and upon the internal surface of the face, where none had just before existed, that the submaxillary gland had been drawn around the jaw and out of the socket during the extraction of the tooth. By gentle pressure of an instrument armed with cotton, and careful manipulation with the fingers upon the internal surface of the jaw, I succeeded in returning the gland to its place. The patient experienced some soreness of the parts during the night, but on visiting me the next evening I found him greatly relieved; and as I have not seen him since, I suppose he has not experienced any further trouble.

The Secretary then read the following paper:

DENTAL DECAY AND FILLING MATERIALS CONSIDERED IN THEIR ELECTRICAL RELATIONS.

BY S. B. PALMER, M.D.S., SYRACUSE, NEW YORK.

Mr. President, and Gentlemen of the Odontological Society: Having had the honor of election to associate membership in your Society, and being permitted to take part in your deliberations and share your hospitalities, it gives me great pleasure to present to you the following thoughts and deductions, as a contribution to the fund of general professional knowledge.

In presenting the conclusions to which my investigations have led me, I desire to say that, like the experiments upon which they are founded, they are independent of all parties, sides, or "departures," as such; for I believe that from the moment truth is sought on only one side of any question, investigation in that case becomes untrustworthy. Still, I wish to subscribe to certain new doctrines which have, of late years, become public, since I know that they spring from researches conducted in the true spirit of science, and appear to me to be the legitimate conclusions to be derived from undeniable facts.

There seems to be a considerable opposition to these doctrines in the profession, which mainly, so far as I can see, arises from the fact that ideas have been developed and reduced to practice through the agency of materials not heretofore considered as of the greatest utility or beauty. Yet the results of these ideas are too important to be overlooked or derided. The idea seems to prevail that our new theories are founded upon the use of materials of an order too low to ensure such results as are claimed for them; and consequently, as it seems to me, opposition has been established without proper examination of the subject, and with still less effort to apply those materials where they are calculated to do the most good, namely, to remedy or abolish the failures incident to the best-gold practice. It is to correct this state of misapprehension that I invite attention to those causes which render gold unreliable for use in chalky or poorly-calcified teeth.

At our meeting in November last there were presented ten "articles of faith," each of which comprehended much more of value than could be brought out in any single discussion. The result was, that the whole matter could not but be insufficiently considered, in the space of one meeting. As a text, therefore, for this paper, let me take the first article of that creed.

"Gold is the *best* material with which to save teeth." As I understand, this statement—bold, unqualified, dogmatic as it is—is copied from our text-books. I do not think the profession, as a rule, endorses this dictum. I rather believe that, to meet general views, it should be modified as follows: "Gold is the best material for fillings in cases where it is not incompatible with tooth-bone." Now, as opposed to this, we have the first article of the new creed: "In proportion as teeth *need* saving, gold is the *worst* material to use." This statement cannot be considered so sweeping as the one before quoted, for its very basis is an extremely important qualification. Moreover, while the first is as much, or more, the result of inheritance as of investigation, the second has been evolved from a long series of practical experiments, and depends for its verification solely upon admitted scientific truth. As the two now stand, they represent, not a contradiction, but the extremes of theory and practice as regards gold.

Teeth in a normal condition remain sound so long as there is harmony between the constituent substances of the teeth and the fluid media to which they are exposed. Any change in the latter, particularly if it produces an acid quality, is manifested by a softening or wasting of the surfaces of the teeth. This is a simple and well understood form of chemical action, and operates, as has been said, upon the whole exposed dental surface.

A second form of deterioration of tooth substance is productive of cavities, through local action upon definite portions of a tooth or teeth.

This usually occurs while the teeth and fluids are in a normal condition, through the lodgment and retention of particles of food or extraneous matters, until reaction or fermentation occurs in such places. This may be termed local, as the first instance may be called general, chemical action.

Here let me introduce, as corresponding to this local action, a simple form of galvanic battery; since we cannot conceive of chemical activity, however slight, without including the idea of a galvanic current. A tooth attacked by caries at a given point is like a battery cell containing the positive element alone—say zinc and an acid. In such a battery chemical action would be slow, with no manifestation of a current. In the tooth, the action which at first was simple soon becomes complex. When the lime salts are dissolved, the remaining cartilaginous portion corresponds to the porous cell of a Daniell battery. This comparison will, I think, aid in solving the question of why a tooth, having begun to decay, will sometimes cease that action altogether.

It was stated, in the discussions of the November meeting, that electricity has little to do with promotion of dental caries, and that we must look to chemical action for the causes of decay. Unless we can have a better understanding of the relations of chemical and galvanic action than is implied by such remarks, further argument on this subject is useless. It is that relation which we must understand; for upon it hang all the principles and forces with which we have to contend. To illustrate my position on this question, let me use, as a figure, ordinary combustion in a furnace. The fire being lighted, the surrounding air is rarefied, and a current or draft is established. The consumption of fuel is determined by the supply of air. With a low chimney, and coal dust as fuel, little heat or power is developed. But, small as is this power, let it be applied to forcing more air upon the slow fire which created it or upon other fires, and we see a great augmentation of power obtained. Now cavities in teeth, lined as they are with softened bone, well represent slow combustion. The undissolved portions resist decay partially. But introduce now any agent which will act more energetically, and this resistance is reduced to little or nothing, and decay progresses more rapidly.

Any material which will offer a perfect and complete protection from corroding agencies will effectually stop and prevent decay. In proportion as it lessens in the degrees of resistance, decay advances. This ratio of failure of resistance depends upon the capabilities of the material as a conductor of heat and electricity. Gutta-percha is almost a non-conductor of both.

Viewed as to extremes, there are two general principles on which decay is attempted to be arrested. One mechanical; the other chemical. The first is that which is by far the most generally employed, and is the only one recognized by many. It consists simply in the exclusion of fluids;

for without moisture or fluid circulation there can be no chemical action. This principle involves the use of any filling material which will meet the given indications. The chemical principle is of use only where the mechanical fails to fulfill the requirements. From this it is apparent that we must know what the requirements are; and further, that we must learn what action is set up between various filling materials and tooth substance.

Let us construct three miniature batteries consisting of three teeth with a cavity in each. The crown and enamel correspond to the cell, the dentine answering for the positive element. In this condition each battery has but one solid element and one pole. The softened bone attached to the sound walls offers resistance to the action of the oral fluids, and thus, in these bone batteries, the consumption of the positive element is slow. To put these batteries into active working order, it is necessary only to remove the resisting medium (excavate the cavity), and supply the negative element in the form of poor and leaky fillings of gold, tin and poor amalgam. Now observe the results to be obtained from these batteries.

With batteries in action the current obtained is according to the differences of the elements. Thus, platinum gives better results with zinc than with copper, and with copper better than with tin.

In our tooth batteries, the gold element, according to both law and experiment, produces the strongest and most constant current, and therefore consumes fastest the positive element. This result is that which is desired in galvanic batteries for mechanical and other purposes, but is the very thing to be avoided in filling teeth. In fact, the introduction of any metallic filling, under the above conditions, excites chemical action which results in the loss of tooth substance, upon the principles above set forth.

The effect of such fillings in exciting decay is the same as that of a platinum plate when lowered into its place in a battery jar. The metal in both cases forms one pole, around and upon which is gathered electricity opposite in nature to that simultaneously gathered at the other pole. Thus is established a current, which obeys the laws of the electrical phenomena as well in the tooth as in the quart jar. The degrees of the currents in the different batteries differ in the following particulars.

Gold gives the strongest current because it is the best conductor. Its current is the most constant because the metal does not oxidize or corrode. Poor amalgam at first acts in the same manner as gold, though in a less degree, because it is not so good a conductor; but, later, this poor amalgam becomes itself oxidized, and the current is then lessened. Also the metallic coloring matter thrown off by oxidation is received into the softened bone until the once positive element becomes neutral, or in the same electrical condition as the plug. This accounts for the endurance of the black teeth filled, long ago and even defectively, with this quality of amalgam. Tin is low in conducting power as compared with gold. It is, in fact, in nearly the same electrical condition as tooth substance. Therefore the slight current thus evolved is not sufficient to decompose saliva and render acid action continuous. On the contrary, the compound resulting from its oxidation does not destroy vitality and penetrate tooth substance, as does that formed by amalgam.

In conclusion, then, the assertion is made that a certain percentage of teeth which cannot be preserved with gold can be preserved with tin. If facts support this assertion, we meet here a power which we cannot ignore in considering questions as to filling materials. I think it better to at once accept this fact and turn it to account than to argue against the inevitable. In its physical manipulation, gold has no equal as a filling material; but in its chemical properties it is wanting. I advocate the principle, and assert the fact, that gold and tin combined make a filling which meets the indications for beauty, and for preservation of tooth-substance. Our European friends have long since applied this principle, by rolling gold and tin foil together. Such fillings must preserve teeth, although in appearance and endurance they are no better than good amalgam. It is my practice to apply two or three thicknesses of tin foil to the softened walls of the cavity, filling the remainder of the opening with gold, as usual. While these fillings serve all the purposes of gold, the small proportion of tin does not produce discoloration. However, I do not put in any claim for the discovery of a combination of tin and gold, in any form. I instituted my investigations for the purpose of ascertaining the action of filling materials upon the teeth. I am fully satisfied that my conclusions are supported by laws of nature which, at no distant day, will be known, recognized, and reduced to practice, in dentistry, to the improvement of the profession and the good of humanity.

The Secretary then read the following extracts from a letter of Dr. J. Foster Flagg, of Philadelphia:

LETTER OF DR. J. FOSTER FLAGG, OF PHILADELPHIA.

"Every day gives me increasing evidence of the solidity of the doctrines which are advocated by Dr. Palmer, Professor Chase, and myself; and I feel sure that as the minutiæ of our work is taught and examined, so will the rising men of our profession be favorably impressed. It is simply beautiful in its working, comfortable in its doing, compensating alike to patient and dentist, and gives a permanence to results which is only equaled by the most elaborate, arduous, and expensive efforts of the favored few of the first-class workers in gold, and is utterly unapproachable by the mass of good, earnest, honest, respectable men of dentistry! Even granting that such men as Maynard, Townsend and

Varney *have* worked, that such men as Dwinelle, Dixon, Rich, Atkinson, Allport, Allen, Webb and such *do* work, what do all these accomplish in the ocean of *requirement* that lifts its high waves over the whole civilized world? . . . . . Gold has not been able to prevent a large necessity for *artificial* aid. Gold, in our opinion, has *largely added* to this need. This point we mean to urge. This point we mean shall have much thought bestowed upon it. For we believe that teeth, *by millions* (this is an accurate statement, as were all my others), that have been lost, would have been saved had they been filled with something else than gold."

DISCUSSION.

PROFESSOR L. D. SHEPARD (*Boston*): As I have just come from Philadelphia, where I spent several hours with Dr. Flagg, perhaps I can communicate the latest advances in the "new departure." As there are many of our eminent operators who are in the habit of saying that they use nothing but gold for filling teeth, and find nothing else necessary, Dr. Flagg has felt it necessary, as he expresses it, to have on the other end of the beam somebody who shall advertise on his appointment cards, "No gold used." Accordingly, that is Dr. Flagg's position at present. "No gold used. Teeth filled with gutta-percha, tin, amalgam, porcelain and mineral cements."

Since the meeting in November I have revolved this question in my own mind very seriously, and have looked up the records of my own practice. One of my cases has been very instructive to me. It is that of a lady about thirty years old, whose teeth my gold fillings have not preserved. I first filled her teeth about nine years ago; about four years ago I refilled proximal cavities in the molars and bicuspids; and recently I have again filled the same teeth. The first fillings were all of cohesive gold; the second were mainly non-cohesive gold; the late fillings are matters of experiment, being tin or amalgam. In treating one of the lower molars, which had a devitalized pulp, and which had given trouble nine years ago, I put in a compound filling of Hill's stopping and gold; for the reason that, should there be a recurrence of the inflammatory condition, I could easily remove the filling and get at the pulp chamber to prevent an abscess. I placed Hill's stopping in the distal face up to a level with the floor of the cavity in the grinding surface, and then put in a piece of gold plate, extending over the floor of the crown cavity back to the margin of the tooth. On this plate I built with gold, making a gold grinding surface with Hill's stopping in the distal surface. The gutta-percha, put in nine years ago, is still in place, and preserving its part of the tooth; but the gold portion has been replaced within a year. These conditions have occurred in spite of the fact that the gutta-percha occupies the most favorable place for decay, while the gold holds that which is most favorable to preservation. A few such cases have led me to examine this subject pretty seriously. Although, as I do not profess to fully understand it, I have not accepted the theory of the "new departure"; yet I feel compelled to accept some of the statements made by its advocates as to saving teeth.

As cases occur where my fillings have not preserved the teeth, I am adopting, cautiously, a practice of experimentation to determine whether a different method of treatment will produce a different result. I believe that, whatever the course of treatment adopted at any one time in any given case, the conditions of that mouth may become so changed as to produce a different result at another time. And also, if new and quicker methods do not fulfill our expectations in any given case in which gold will fail, at least the time saved by these methods may be sufficient for repeated after-operations, and finally not more than equal that which would have been consumed in introducing a good gold filling.

Dr. Clowes (*New York*): I hear gentlemen speak of a "new departure"; it is an old story with me. For years some of my brethren have called me "old amalgam." I never lose any teeth by my way of doing.

About eight years ago I read a paper on filling materials, of which I enumerated five: tin, gold, amalgam, osteo-plastic and gutta-percha; and of these I said that each was equally good in its appropriate place. These are but few words, yet they mean a great deal. I have not seen any teeth, no matter how soft, which I cannot save by using those materials. Were I to confine my work to any one of those materials, I should lose a great many teeth—unless I except amalgam. I think amalgam will save any set of teeth. There is no need for using gold except for appearances. But that is so important a consideration that gold should be used, in its proper place.

Dr. Fitch: In 1844 I filled with gold the superior incisors of a young lady of eighteen. One year from that time I refilled them. The next year I again filled them. And finally in another year from the last named I cut them off and inserted pivot teeth. There were idiosyncrasies about the patient peculiar to females of this age, and which I then knew nothing about. But my eyes were opened to the fact that there were forces at work, unknown to me or to any others of the profession at that time. It is easy to sit and theorize about chemical action, and to make experiments in the laboratory; but in dealing with occult forces or chemical reactions in living structures we are not quite so certain of either premises or conclusions as, by aid of weights and measures, we may be in the laboratory. For years I have been in the habit of using various substances as filling materials: and I have observed that Hill's stopping, or gutta-percha, as a rule, saves teeth the most surely. Gold will not save teeth having a moist or soft character of dentine. In the hard, flint-like, dry variety, it will. There is no uniformity in mouths ; therefore no one filling material will be proper for all cases.

Dr. Bogue then read the following paper :

THE CAUSES AND TREATMENT OF DISCOLORATION IN TEETH.

BY E. A. BOGUE, M. D., NEW YORK.

Mr. President and Gentlemen: In view of the subject which came up at our last meeting, under the head of "Incidents of Office Practice," I have been requested by the Executive Committee and President to prepare a short paper upon the subject of the cause and treatment of discoloration in teeth.

I undertook to comply with the request with considerable diffidence, as at the late hour given me for preparation there was not time for the extended experiments necessary to demonstrate beyond controversy the status of a number of the processes which, up to this moment, so far as I know, are merely empirical.

I shall be obliged, therefore, to content myself by referring first to a few anatomical facts, the forgetfulness of which sometimes leads to the discoloration spoken of; and secondly to a few technological facts, which may be useful in the majority of cases in removing that discoloration. The principles underlying these facts will necessarily be only incidentally alluded to.

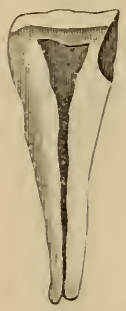

Fig. 1.

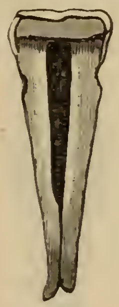

Fig. 2.

To begin, then, with the anatomical features.

As most of the trouble with discoloration is in connection with the six front teeth, it will be sufficient to call attention to *their* construction, without undertaking a review of the remaining teeth.

Referring now to Fig. 1, I will call attention to the size and shape of the pulp cavity relative to the tooth and to its position in the tooth.

Splitting an upper incisor lengthwise and from side to side, we find the pulp chamber to be nearly cylindrical in the root, while it spreads laterally in the crown in a manner corresponding somewhat to the shape of the crown itself, forming a receptacle for the pulp, shaped somewhat like an oar, with the blade sometimes rounded at the end, and sometimes shaped like a trident. (See Fig. 2.)

Figs. 3 and 4 represent incisors split perpendicularly from front to rear; this again shows the cylindrical portion of the pulp, like the oar handle, the curve of the blade, where the pulp spreads out in the crown, and the distance to which it dips toward the incisive edge.

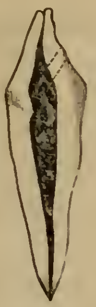

FIG. 3.

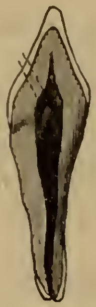

FIG. 4

These same characteristic features are to be found in all incisor teeth, though not as distinctly marked as in the upper centrals, while in the cuspid teeth (Fig. 5) the pulp maintains its cylindrical form down to the point where it begins to taper toward its end, and as there is no broad and flat incisive edge to the cuspid teeth, so there is no broad and thin portion of the pulp lying within, as there is in the incisors. (Figs. 1, 2 and 6.)

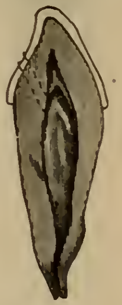

FIG. 5.

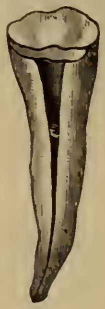

FIG. 6.

These particulars it will be necessary to bear in mind, in order to fully apprehend not only the *manner* of discoloration, but also to understand the cause of the frequent failures in the efforts to either prevent or remove it.

If, for example, the pulp in a central incisor tooth becomes, from any cause, congested, that very congestion may itself produce strangulation of the pulp at the apicial foramen, just as effectually as though it were ligated, and much more disastrously; for, up to the point of stasis, arterial blood is being forced into the pulp without the possibility of exit.

Immediately upon the death of the pulp, the dissolution of its elements commences; with the formation of the gases of decomposition the blood globules are burst, their contents come into direct contact with the mouths of the tubuli, the pressure from within the pulp cavity continues, capillary attraction operates within the tubuli, and the dentine becomes injected to a greater or less extent with the hematine, constituting the coloring matter of blood, in which, also, iron is found.

Aside from the hematine, there are in the blood about 75 parts in 1,000 of albumen, and a still further amount in the connective tissue of the pulp, which may in various ways be instrumental in producing the state which we have under consideration.

It is not only coagulable, as is elsewhere stated, thus becoming an impediment to bleaching out the hematine discoloration, but it is also subject itself to putrefaction, like all of the protein compounds which are composed of oxygen, hydrogen, nitrogen and carbon, the latter being, as you know, in one of its forms, intensely black, and almost or quite insoluble in anything. (If this is questioned, try to dissolve some animal charcoal, and be pleased to let us know the result.)

An effort is now perhaps made to remove the pulp, and a hole is accordingly drilled in the tooth in the direction of the dotted lines, which, it will be seen, is admirably adapted for removing the pulp from the root canal; but at this stage of decomposition, when there is no longer any coherence to the pulp as a body, no efficient progress can be made through this opening toward removing it from the crown.

Accordingly, the root being cleared out and filled, the thin pulp chamber in the crown is mostly ignored, and remains for months, or even years, a source of ever-deepening discoloration.

It will be remembered that the dentinal tubuli are largest at their point of opening into the pulp chamber, and that the circulation in them proceeds from within outward toward the periphery of the tooth, after the manner in which sap circulates in a tree or bush from the ground upward, through the trunk, branches and twigs, the openings ever increasing in number but diminishing in size, somewhat after the fashion of these same dentinal tubules.

These tubules at their mouths, and for a little distance along their largest diameters, average about $\frac{1}{10000}$ of an inch. Reference is made to this now, because it will be seen that while much of the discoloration with which we have to deal proceeds from the contents of the blood corpuscles, which vary from $\frac{1}{2800}$ of an inch, to $\frac{1}{4000}$, the average blood corpuscle is therefore about three times as large as the tubuli, and so is unable to enter them. The tooth pulp which supplies the circulating fluid to the dentine, as well as the sensory nerve fibres, contains at least one artery (which subdivides in this tooth pulp into a multitude of smaller branches), and a corresponding vein with its branches leading outward

This pulp, although containing these vessels filled with blood, presents in its normal condition somewhat the appearance of aponeurosis—pale, glistening and opalescent; but in a state of irritation it becomes red and turgid with blood, which is at these times present in the pulp to several times its usual volume.

This is probably the state of the pulp when some of the most marked and rapid discolorations occur, which so perplex us and annoy the patient.

We see, therefore, that any cause which results in the destruction of the pulp of the tooth is liable to bring discoloration in its train—exposure from decay, too great proximity of a metallic filling, a careless stroke of an excavator, a blow, too sudden movement of a tooth in process of regulation or separation, the application of strong caustics, beginning with arsenic, or sudden congestion from any causes, such, for instance, as hanging or drowning, are among the causes which may produce this result as a sequence; the discoloration in all these cases, however, being due, first to the hematine of the blood, and secondly to the putrefactive decomposition of the pulp.

This process is a complicated one, and, as Dalton says, "is characterized by a gradual liquefaction of the animal substance, by many mutual decompositions of the saline matters which are associated with it, and by the development of peculiarly fetid and unwholesome gases, among which are carbonic acid, nitrogen, sulphuretted, phosphoretted and carbureted hydrogen, ammoniacal vapors.

"Putrefacation takes place constantly after death, if the organic tissue be exposed to a moist atmosphere at a moderately warm temperature.

"It is much hastened by the presence of other organic substances in which decomposition has already commenced."

Among the other substances which produce discoloration of the teeth may be enumerated iodine, nitrate of silver, and the mixture of iodine and creosote, which has been, and, I believe, is *still* extensively used in the treatment of abscesses at the roots of teeth.

The other discolorations following the use of certain remedies—notably *iron* and such as supervene from the use of tobacco, or from lack of cleanliness in the mouth—are external, and do not legitimately belong to the class of cases which we have under consideration.

To turn now to the processes of treatment. The last cause mentioned for discoloration was the solution of iodine in creosote, used in the treatment of abscesses. For this discoloration I do not yet know of any efficient remedy, though hyposulphite of soda may be of some service. Nitrate of silver stains, as you are well aware, may be removed, though slowly if of long standing, by cyanide of potassium, or, better, by first saturating the stain with iodine, forming iodide of silver, and then dissolving that with hyposulphite of soda or aqua-ammonia.

Iodide of silver is also soluble in any alkaline hyposulphite.

(Four stripes were here painted on white paper—nitrate of silver, iodine, sulph. iron, and creosote and iodine—a stripe of each.)

(*Dr. Dwinelle then remarked as follows:*)

Dr. Dwinelle: May not there lie a chemical influence behind those tints which are put upon the paper? May not the paper itself act as an agent or re-agent to change the character and quality of the material which is placed upon it? For instance, the first stain is iodine—that is, iodine laid upon paper. Paper contains its quantum of albumen. It is bleached by chlorine. So we are not starting at the bottom after all. This may account for the fact that the ammonia does not bleach that iodine instantly. Drop a little iodine on the finger, and wash it in ammonia, and it will be bleached in a moment.

Dr. Bogue: The doctor will find that referred to in a moment. I presume there are chemicals in the paper. Suspecting that condition, I took a cambric handkerchief and found the same results produced by the agents which I shall use this evening; and, finding the same results, I took the white paper, as being more convenient, and as showing the experiments at a greater distance, so that all who might be in the room could see them distinctly. I have marked those four stripes on the paper, the top one being iodine; and, as an illustration of what may be done, I will brush all those different substances with the different bleaching agents generally used in bleaching discolored teeth. In the first place, ammonia; second place, hyposulphite of soda; third place, Labaraque's solution of chloride of soda; fourth, chloride of zinc; fifth, sulphurous acid; sixth, oxalic acid. It will be noticed that scarcely any of these substances save the oxalic acid has had any special effect upon the iron stain. The others are as you see them, more or less changed from their original shades of color.

I must say right here that I never attempted to say anything before this Society with so much embarrassment or hesitation as at the present moment. The more consideration I have given to the subject (and I have not had much time to work upon it) the more I see I do not know anything about it. The causes which act to produce the discoloration spoken of a month ago I thought, four days ago, I could explain. To-night I am again in ignorance; and I simply say that this is an investigation in which my tiny effort can be but the entering wedge. I think I have seen teeth discolored by the mixture spoken of (iodine and creosote) and, as stated in the paper, I do not know an efficient bleaching agent. The best one, as you see, is the hyposulphite of soda.

Iodine is removable by hyposulphite of soda. Iodine stains upon the hands may be removed, when fresh, by aqua-ammonia. Being extremely volatile, I have occasionally used heat with good effect in removing stains of iodine, and this led, I think, in connection with some other experiments, to a somewhat valuable discovery, which will be described further on.

We recur now to the various methods of removing the stains caused by the disintegration or decomposition of the tooth pulp.

Disintegration may occur without the destruction of the pulp. All the cases that I have seen, and they are but few, have arisen from the application of arsenic to the tooth, for the purpose of obtunding sensibility during excavation ; in these cases the blood globules seem to have burst, and the dentinal tubuli to have become injected by their contents, which preserved a bright red color, as is always the case, according to Kölliker, in the presence of "all concentrated solutions of metallic salts, unless they exert an immediately destructive influence." This explains perfectly why some teeth should be red or pink in their discoloration, instead of blue, black or brown, as is usually the case.

These red teeth, if living ones, as they usually are, of course are not amenable to treatment.

We have thus narrowed our field by exclusion, down to those cases in which decomposition of the pulp has taken place to a greater or less extent, with absorption of the products of such decomposition by the dentinal tubuli.

The process has, up to this point, probably been spontaneous, and the question of removing the stain from the tooth is a comparatively simple one, especially if it be a young subject.

But, unfortunately, these cases have often been complicated by those into whose hands they have fallen, by efforts to *treat* the tooth, as it is termed. Creosote, carbolic acid or iodine, any two or all three of these substances have been used inside the tooth with the effect, theoretically speaking, of more or less solidifying all the albuminoids that may have been present.

Now nerve tissue contains seven per cent. of albumen, about ten per cent. of phosphorus, fat and salts, and all the rest is water.

Blood contains nearly as much albumen in proportion, fibrine included, all of which in a fresh state is coagulable by the substances just mentioned and by several others which we are in the habit of using.

Insoluble compounds of albumen are formed by several metallic solutions, and in these cases should the coloring matter of the blood have first come in contact with, for instance, some of the potassa salts, which make the blood black, instantly, as do also several of the alkalies, and then with some of the metallic solutions or creosote or carbolic acid, we should have a tooth injected with the black dye within the dentinal tubes, and we should have the mouths of those filled with a more or less insoluble albuminous compound, which we might try in vain to remove.

Should we have, however, only an ordinary coagulum of albumen, *that* is soluble in caustic alkalies, but such agents are to be used sparingly and with great care, as are also the dry chlorides, being in my view more dangerous to the integrity of the tooth, if frail, and consequently to its future strength, than any of the acids which we are called upon to use.

Should the discoloration be due to an injection of the tubuli with the carbonaceous products of putrefaction, the prognosis is unfavorable, owing to the insoluble nature of the deposit.

Before commencing the bleaching process on any tooth, it should be isolated by the rubber dam, a careful excavation should be made of all extraneous matters from the cavity of decay, and the pulp chamber and its canal or canals should be carefully filled; then a thorough drying should be made of the whole tooth, with the warm air syringe. When everything is thus dried, the root having been carefully filled, which should always be preliminary to the use of chemicals inside of any tooth, if the discoloration proceeds from hematin or iron, a drop or so of a saturated solution of oxalic acid in water should be put into the tooth by a hypodermic syringe, and the syringe withdrawn.

If now the tooth be watched from its face, in a few minutes—varying from three to seven or eight—the satisfaction may be experienced of seeing the discoloration fade away and disappear.

When the normal color has been restored, the tooth should be thoroughly washed, by syringing it with clear water in abundance; of course towels will be supplied to catch the water, as it regurgitates, otherwise a filthy and, perhaps, ruinous operation will be the result, should the chemicals chance to get upon the clothing.

Before going further, I will exhibit the action of oxalic acid upon the salts of iron.

Previous to doing so, however, I will show the action of chlorine, ammonia and hyposulphite of soda, each of which, although an admirable bleaching agent in its place, is contra-indicated in this case.

(Experiments were here tried, consisting of applications of chlorine, ammonia, hyposulphite of soda, sulphurous acid, and oxalic acid, upon broad stripes of persulphate of iron, painted upon white paper. That the reader may get the force of these simple experiments, he is recommended to apply with a camel's-hair brush some common iron-and-tannin ink, or persulphate of iron and nut-galls dissolved in water, upon a sheet of white paper, and, after drying a little, to apply upon the iron stripes the various bleaching agents described.)

As there are three chlorides in use, I will apply all of them. First, chloride of lime; second, chloride of zinc; and, lest it should not be strong enough, I use 420 grains to the ounce; then chloride of soda; the next is ammonia; the next is hyposulphite of soda; the next is sulphurous acid; the next is oxalic acid. It is hardly necessary, as you see, to take into account the ulterior reactions which may exist in the paper on the action of those various substances on the iron.

Having exhibited these experiments, I will refer to a process which has been proposed by certain gentlemen for bleaching teeth, which is that chlorine gas should be generated in a retort and conducted to the tooth by a pipe, the patient meanwhile being protected from the acrid fumes by a huge sheet of rubber, behind which he is supposed to live and breathe, free from the gas which is being discharged into his tooth, and which, according to Roscoe, when present in large quantities produces inflammation of the mucous membrane and causes death when inhaled; yet for the sake of bleaching a tooth we have been treated to elaborate descriptions of how to do it without killing the patient, although it is conceded that there is some danger.

The fun of this beautiful chemistry is that dry chlorine gas does not bleach; a piece of cloth or paper colored by a vegetable substance, in a bottle of dry chlorine, remains unchanged after the lapse of many weeks; if water is added the chlorine decomposes it and forms *hydrochloric acid* at the moment the bleaching takes place.

It will be remembered that the use of chlorine gas was suggested in order that deleterious acids might not be brought in contact with the teeth ! ! !

Some years ago an article appeared in a dental journal from one of our well-known practitioners, advocating the use of oxalic acid for bleaching teeth, but directing that the tooth should be carefully washed with aqua-ammonia, and all traces of acid neutralized before proceeding to fill it.

Let us try what effect aqua-ammonia has upon the salts of iron that have been completely bleached out by oxalic acid.

(Aqua-ammonia being brushed over the spot that had been bleached by the oxalic acid, the color of the iron was almost instantly restored to nearly its original blackness.)

I think, after witnessing the result of this neutralization of an acid with an alkali, that it will scarcely be necessary to say that the tooth should be washed only with clear water after bleaching. The tooth having been bleached to the requisite degree of clearness and not too white, and washed free from all traces of acid, the question arises, how are we so to fill it as to make sure that it will not again turn dark?

Before answering that question it will be necessary to inquire what causes operate to turn it dark again, after once a filling of white oxychloride of zinc or gutta-percha has been inserted? The answer is this: gutta-percha does not adhere to the tooth, unless the tooth is so heated from the outside as to render the gutta-percha plastic beneath it, and adherent; unless, therefore, this is done, we may be sure that a film of moisture filled with organic substances will sooner or later find its way between the gutta-percha and the tooth; moreover, gutta-percha has sometimes an unfortunate way of swelling, and is said to have done damage; lastly, it is difficult to procure gutta-percha that is light-colored enough to answer this purpose.

The next substance most commonly used is oxychloride of zinc, which has been highly extolled, first, because of its color, second, because of its strength, third, because of its porosity, which would absorb any small amount of moisture, and fourth, because of the chlorine, which, it has been claimed, would still further assist in bleaching the tooth into which it might be placed.

Let us carefully examine these qualities and see which of them are desirable.

Strength unquestionably we wish; therefore the stronger an oxychloride or any other filling, the better for our use.

Porosity is desirable, if any fluid should ever penetrate to the filling, but not at the expense of strength; therefore the strongest is to be selected. Chlorine, which is said to assist in still further bleaching the tooth, is the next quality.

We have seen how washing the cavity with an alkali after bleaching operated; let us now see how the presence of chlorine after bleaching operates, and perhaps we shall be able to discover why so many teeth have again grown dark after having once been pretty successfully bleached.

(The chlorine upon being applied to a spot previously bleached with oxalic acid and now nearly dry, turned the spot a dingy brown. Another spot became yellowish brown, while a fresh spot, just bleached, was apparently not changed at all, for the moment.)

This experiment shows us that those oxychlorides of zinc in the use of which a considerable amount of chlorine comes in contact with tooth substance, must necessarily produce as a result a darker reaction; those in which the chlorine has been least manifest, whether because of the less amount of chloride in the fluid or of the less amount of fluid used, have invariably done the best, while those that have been used expressly to get the action of the chlorine have done the worst.

The remedy for this condition of things we will consider in connection with the fourth and last quality of oxychloride of zinc used for this purpose, viz., its color.

Undoubtedly this can be made to approach more nearly to the color of the tooth than any other material with which we are acquainted; but it is after all a dead and opaque color, and even when successfully inserted with no superabundance of chlorine, it gives the same opaque look to the tooth which it has itself. How is this to be corrected?

You will remember that, in connection with an effort to get rid of iodine stains, I stated that I employed heat to the tooth externally by hot irons and internally by hot air. At the conclusion of this process, on one occasion, wishing to be rid of the chlorine in my oxychloride of zinc, I varnished the inside of the tooth with copal dissolved in ether, such as is prepared by Mr. Fletcher for varnishing cavities.

The result was such that on the next occasion I went a step further, and not only got rid of the chlorine effects, which I intended, but also got rid of the dead, opaque appearance which characterizes oxychlorides. I varnished my cavity with copal and ether, and on the top of that with mastic dissolved in alcohol.

Since the adoption of this plan I have obtained some most beautiful results in the translucent appearance which the tooth has presented after the completion of the operation.

DISCUSSION.

Dr. Kingsley: How do you account for the translucence named in the last instance, since it did not exist before? Did it arise simply from introduction of a translucent substance?

Dr. Bogue: I think so.

Dr. Kingsley: But there was behind that the oxychloride.

Dr. Bogue: Certainly; but you are partially rid of that peculiar chalky look which oxychloride has, and which it imparts to tooth substance against which it is brought by direct contact.

Dr. Clowes: It must be a colorless varnish.

Dr. Bogue: It is almost colorless.

Dr. Clowes: If, as Dr. Bogue has suggested, this varnish is an aid to bleaching, it is important. The most valuable information which I get from the paper is that we must not bleach at all; because, as soon as we have done so, the after application of something else will render our bleaching efforts useless. My impression is that discoloration comes mainly from the dead pulp. I had a case where the tooth was dark from that cause. I cleansed the root thoroughly, washed it with warm water, and filled with osteoplastic. Now that tooth looks as alive as the one beside it. I have practiced thus for years. I gave up bleaching long ago. There is no necessity for it. Pursue the course I have stated, and the best results will be obtained.

Dr. W. H. Dwinelle: I think Dr. Clowes is mistaken in supposing the best results follow his course every time. All kinds of circumstances, many of them contradictory, are met with in bleaching teeth, and it would be strange if osteo-plastic would invariably succeed. I think Dr. Bogue has to-night demonstrated that these things depend on such delicate chemistry that we cannot, at present, always expect perfect results. I have not succeeded to the extent that Dr. Clowes states that he has. While I have generally succeeded to my satisfaction, I have not always done so. While I have not always been entirely successful, I think I have invariably produced great improvement.

I saw a case a few days ago in which I operated in 1856, with entire success. The tooth, a superior frontal incisor, is as perfect in color as when I left it. The dead tooth is not distinguishable from its living brother by its side. I have seen other successful cases of much longer standing, and I have also seen cases which, successful at first, have since retrograded more or less. As to why the oxalic acid treatment is not always a success, we may get a hint from photography. If the photographic print is not sufficiently washed, the chemical action will go on to the ultimate destruction of the picture. The oxalic acid should be thoroughly washed out of the tooth, and no attempt should be made to neutralize it with an alkali, for good reasons demonstrated here to-night.

As to heating the teeth, some may be doubtful of the results which would follow that practice. A black tooth is generally a dead tooth, hence there can be little apprehension in that direction. And then, the amount of heat, if properly applied, which even living teeth can bear without damage, is astonishing. I have treated a living front tooth, with a large labial cavity, by partly filling it with Bevins' gutta-percha stopping, delicately fitting a section of enamel from a natural tooth to the orifice, smearing the enamel section with the same material, and then holding it in place with little wedges of ivory while I applied sufficient heat to the tooth to cause the filling beneath and smeared material to run together and permanently fix the enamel section in place. This was done sixteen years ago, and the whole is still perfect and beautiful.

Adjourned.

Meeting of March 19th, 1878.

After the meeting was called to order, Dr. A. L. Northrop narrated the following

CASES IN PRACTICE.

BY A. L. NORTHROP, D.D.S., NEW YORK.

The first case I shall call your attention to this evening is one which has been under my observation for the last fourteen years. About that time ago, a lady came to my office, having an epuloid tumor between the second bicuspid and first molar of the left side of the upper jaw. It was vascular, and about the size of a small walnut. She stated that during the previous four years similar tumors, in the same place, had been four times extirpated by different surgeons. I clipped it off with my scissors, considerable bleeding ensuing. Ten days afterward (she having been absent from the city in the meantime), the tumor had again grown to about half the size it had when last removed. I removed the new growth, and then, by the agency of chromic acid, ate the soft tissues away to the bone, which I scraped thoroughly. The gum healed nicely; and during the succeeding eleven years, the patient being under my observation all that time, no new growth occurred. At the end of that period the patient married and soon became *enceinte*. After about three months of pregnancy the tumor reappeared, and was removed, by ligature, just before her confinement. From this growth I had two specimens made for the microscope, which showed it to be myxomatous, non-malignant. After her confinement the gum healed, appearing normal, and continued in that condition until about two months ago, when the lady again became pregnant; and now the tumor is again growing, having already attained to nearly the size of a walnut. What its character will now prove to be I do not know; but as the growth has been promised to me, the microscope shall decide the question immediately upon its removal.

Another case is that of a lady who, on the first of February last, applied to me to have a right central upper incisor restored. The crown had been broken off and built up with gold, which had then broken away. Upon examination by touch I noticed that the tooth, as compared with the others, was quite loose. The patient stated that the root had been drilled through. I removed the remains of the gold filling, and, upon passing a probe, obtained a discharge of a poor quality of pus. The root was syringed and an application made of creosote and oil of cloves, equal parts. Upon removing the dressing on the following day, a discharge similar to the first occurred. The former dressing was renewed with a similar result. I now applied chloride of zinc, 240 grains to the ounce, working it through the foramen and applying a dressing so tightly as to prevent discharge through the tooth. The next morning the gums were swollen. I lanced the swelling, and then, upon using the probe, discovered a pocket three-quarters of an inch deep, passing backward and into the alveolar process. A more careful search revealed the presence of slight necrosis of the alveolar plate. Further, upon the root itself, from half to two-thirds of the distance upward toward its apex, were three little rounded grooves passing across its length and equidistant from each other, having smooth surfaces, and showing no signs of having necrosis for their origin. They might, as far as description is concerned, have been made by a burr drill crossing the root. I have never before seen this peculiar condition, and shall not attempt to assign a cause for it. The most of the alveolar plate over the root is gone. I at first made three or four applications of aromatic sulphuric acid, but have latterly used chloride of zinc, to induce granulation. To-day the sac is almost entirely filled, no discharge occurs, and the case is doing well. The day after to-morrow I intend to restore the crown.

On the 13th of November, of last year, Mrs. J. came to my office suffering acute pain in the region of the right inferior lateral incisor. All her teeth, excepting the four lower incisors and left lower canine, had been extracted previously. On examining the tooth of which she complained, I found the pulp slightly exposed. An application of carbolic acid was made without relief. A second, of carbolic acid with aconite, seemed to have some effect, and the patient then went away. In the evening of the same day I called at the patient's home, and found that the pain had been very severe all day. I then applied carbolic acid and aconite to the tooth, and aconite to the gum; which, having been repeated once or twice during the next two hours, gave great relief. But the next morning the patient again came to my office, saying that she had passed a sleepless night, was nearly distracted with pain, and wanted the tooth extracted. This I refused to do; for I thought that the extent of pain in the head and face was greater than could properly be attributed to the tooth alone. The gums of both jaws appeared normal, with no greater irritation than would be expected from the aconite applications. Upon pressing strongly, with my finger, upon the gums, I discovered that the pressure, when over the region of the right lower wisdom tooth, greatly increased the pain. The patient stated that she had worn artificial teeth for seven years past, and thought that all the teeth had been extracted. I told her that I thought an unerupted tooth was the cause of her pain, and, having lanced the gum and passed an exploring instrument to the bone, found an unerupted wisdom tooth, which I extracted. The patient was then dismissed, still suffering intense pain, and promising to send word if relief was not obtained by the operation. Two days afterward I was sent for by her. I now found the right cheek much swollen, the swelling extending downward upon the neck. Upon examining the mouth, the submaxillary gland was found to be much enlarged and hard to the touch. The pain was everywhere great, but most intense in the region of the ear and at the mental foramen. I syringed the cavity from which the unerupted tooth had been extracted, and applied camphor and glycerine. The gum continued to swell, especially in the region of the sub-maxillary gland and right first molar, although there was little or no swelling about the socket of the extracted wisdom tooth. I now used aconite to relieve the pain, and painted the gum with iodide of zinc. In about a week or ten days afterward, I lanced the gum in the region of the right lower first molar. The lance blade passed into a pocket in the bone and pus escaped freely. A careful probing proved that the pocket was of considerable extent. I detected necrosed bone, and made application of aromatic sulphuric acid. The sub-maxillary gland continued very hard and much swollen, causing difficulty in speaking and swallowing. The pain during the day was now slight, but caused much suffering during the night. There was also, at night, numbness of the lip on that side of the face. I removed two small pieces of necrosed bone; but over two months passed before the pocket and socket filled up and the patient recovered. I have filled the lateral incisor. In damp or cold weather there is still a little pain in the affected side. I have been at a loss to know whether the original pain was caused by the unerupted wisdom tooth, or came from the pocket or cyst in the bone.

[Since this meeting, the recurrent growth, mentioned in Dr. Northrop's account of the first case in this paper, has been again removed, and examined microscopically by Dr. Carl Heitzmann, of this city. The following is his account of its appearance.

"The tumor proves to be composed of a delicate net-work of fibres, in the meshes of which are imbedded round, granular elements in a varying number. The central parts of the tumor have relatively few such elements, and its character is, in this situation, that of a *myxoma;* while the peripheral parts, being provided with numerous elements, assume the character of a *myxo-sarcoma.* The growth is very richly vascularized, mainly with veins and large capillaries. It therefore is analogous to those myxomatous tumors which grow from the mucous lining of the pharyngeal cavity, so called *polypi,* which are benign in character, but very prone to recur after extirpation. A section from a former growth of the same tumor exhibits the same features as the present one."]

DISCUSSION.

Dr. Miller (*New York*): Did the wisdom tooth incline toward either side?

Dr. Northrop: No, sir. It stood as nearly perpendicularly as one would expect a wisdom tooth to stand. Upon its side it was a little necrosed, this condition extending over the end of the root.

Dr. Jarvie (*Brooklyn*): In the case of the recurrent tumor, when you ate away the soft tissues, did you discover any caries or necrosis of the bone?

Dr. Northrop: I did not. There was a slight roughness of the bony surface, such as I have noticed in other cases where such tumors had been removed. The bone was not softened, but its texture was cartilaginous.

Dr. Jarvie: You cut it?

Dr. Northrop: I cut away until I had arrived at healthy bone.

Dr. Tenison (*New York*): Have you any theory as to the recurrence of the tumor?

Dr. Northrop: Not one which is sufficiently developed to present to this body.

The following paper was then read by the author:

OFFERINGS.*

BY J. F. P. HODSON, D.D.S., NEW YORK.

1. Bibulous paper cut into long diamonds—say three inches long by three-fourths of an inch wide—and twisted lengthwise into a smooth, hard, double-pointed thread, and kept on hand in quantities, will be found especially adapted, and very excellent, for drying out pulp canals after the bulk of the moisture shall have been removed with the ordinary rolls or pellets; inasmuch as the paper threads will penetrate the canals to their extremities, and *absorb* the contents, without the tendency to pack the latter at the upper end of the root, or push them through the foramen, which cotton wound upon a broach possesses.

2. A pledget of wet spunk in the tweezers will take up the finishings from gold fillings wherever they may have fallen—either upon the teeth, dam, or mucous membrane—and is a good substitute for the spittoon trap for saving gold—the pieces loaded with waste gold being thrown into the vessel of water usually kept for the purpose of rinsing gold from files and burrs, and burned out in the final melting of the total washings.

3. If, after having applied the rubber dam, it be found that the holes have been placed too near together in any place, or any one slightly torn in applying, and that in consequence the moisture exudes about the teeth, a small pledget of the spunk wedged between the teeth at their necks, from both the buccal and lingual surfaces, and so treating one or two spaces on each side of the tooth to be filled, will entirely obviate the difficulty. Even though the pellets do not wedge back the leakage *in toto*, but require changing, even two or three times during the operation, it is unquestionably better to thus compromise with the error of judgment than to subject the patient to an entire reapplication of the dam. It is hardly necessary to observe that this course is not an admissible one, when the exudation comes from the space where the filling is being done.

4. A veritable "friend in need," sometimes, is a little appliance which I may call a "rubber dam stopper," with which an accidental puncture of the rubber may be *quickly* and *certainly* sealed. In the earlier years of the rubber I employed ordinary corks for this purpose; but from the difficulty of keeping them in their place, their liability to suddenly jump out of the opening and flood an operation, and the large amount of room which they absorbed, I some years since substituted

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* Dr. Hodson does not wish to be understood as claiming originality of invention or discovery for any of the "offerings" he presents. They are simply things from which he has derived much benefit in his practice; and he hopes that those unacquainted with any of these items may derive similar benefit from them.—ED.

these appliances. They are simply disks of any suitable material—hard rubber, soft rubber, cork, etc.—say one-fourth to three-eighths of an inch in thickness, with a deep groove cut entirely around their circumference, and equidistant from each face, thus producing, after all edges shall have been nicely rounded, something akin to two round-edged buttons placed face to face, and which may be caught up with the tweezers, and in an instant pushed half way through the puncture, the edges of which close into the deep groove, and so entirely seal the opening. This leaves but a little flat button on either side of the rubber, and consequently involves no loss of room or light, while the groove keeps the appliance perfectly in position. I keep by me half a dozen different sizes, from one-eighth of an inch to one inch in diameter at the bottom of the groove, which variety I have always found sufficient to render instantly harmless any reasonably sized puncture of the dam. They may also be valuably employed in such cases as one's having made a miscalculation in cutting the holes for any particular operation or having torn the rubber in the effort to pass it between teeth, or where one chooses, as many do, to employ the same piece of rubber more than once, by tearing out the isthmus of rubber between the holes, and placing one of these appliances in the single opening thereby produced; after which the rubber may be treated in all respects as a fresh piece. It is seldom, surely, that a skillful operator will need these appliances for punctures; but when they *are* wanted, the need is very sore and urgent.

5. The exquisitely thin sheets of cork which are used by hatters will be found a very convenient form of this material from which to cut small pieces to be placed upon the floors of cavities, as non-conductors of thermal changes.

6. An excellent precaution, in the preparation of pulp cavities, when cutting is to be done for the purpose of enlarging the opening, etc., is to push a little pledget of cotton up or down *each* root beforehand, and beyond where any operating is to be done, to be left there during the operation. It will save the real annoyance of any chips or refuse becoming lodged in the roots, and *assurance* is had of their cleanliness by its withdrawal afterwards.

7. A buffer, made by covering a block—say, 3 or 4 inches long, by 1½ inches wide, and ½ inch thick—with leather, covering this again with chamois, and rubbing a little rouge upon the surface, is convenient to have in the operating case, to polish the burnisher upon *each time* before carrying it to a filling. It will then really accomplish its purpose of *burnishing*, and not drag the surface of a filling, as it would if clogged with gold from a former burnishing.

8. I would suggest to such of my professional brethren as have not already done so, a trial of the compound solution of iodine (commonly

called "Lugol's Solution," and the formula for which may be found in any U. S. Pharmacopœia) in most, if not all of the places where tincture of iodine has been the usual remedial agent. It is an aqueous solution instead of an alcoholic one, and as such has, especially when topically employed, greater affinity for the tissues, and a consequently greater *penetrative* action; and inasmuch as the ultimate action of iodine is that of an urgent appeal to the absorbent system for its especial activity, this is certainly a valuable consideration in the directions in which we employ it. This quality, as well as the fact of its being more concentrated than the tincture, adds to its value as a rubefacient, or as a mild counter-irritant. It cannot but be patent, moreover, that for abscessed conditions it should be superior to the tincture, because of the instant coagulation by the alcohol in the latter of the albuminoid constituents of the pus, particles of dead pulp, blood, etc., remaining in the deeper portions of the canals, or weeping into them during the operation of dressing, whereby, instead of cleansing the pulp canals and the tubuli of their contents, as we are earnestly desirous of doing, we are in reality filling them up with undissolvable particles of coagulated albumen, to be possibly pushed through the foramen at the next dressing, to perpetuate, or, at the least, prolong, an abscess, if there be one in active operation, or to develop one, if it be still undeveloped. (It may be well to say here that I do not wish to be understood as counseling the employment *inside the tooth* of *any* preparation of iodine; but in the case of its *being* used, suggest this preparation of it as the one least likely to cause after regret.) In view of these considerations, and the additional very serious one consequent upon them—viz., that if these albuminoid matters be fixed by coagulation, especially in the tubuli—all subsequent attempts to change for the better the color of the tooth, short of actual cutting out, must prove practically fruitless—it has long been my conviction that alcohols in any form—including, very especially, the *quasi* alcohols, carbolic acid and creosote—should never be allowed to *touch* the pulp canals or their contents, until by thorough and persistent cleansing with warm water, alternated with the use of the absorbent paper needles mentioned at the beginning of this article, the canals and tubuli shall have been as thoroughly cleared and freed from foreign matters as it is possible to make them by these means—nor even *then*, if, on the one hand, the tooth be dark-colored, and require blanching treatment afterwards, or, on the other, if pus or blood can weep into the canal from an unfistulated abscess. In fine, I consider the above remedies, *per se*, excellent weapons with which to war with "pus conditions," but *I do not believe the pulp canals to be a fitting place for such encounter*.

My method has long been, upon opening a dead tooth, and after cleansing as thoroughly as possible with water, broaches, paper needles, etc., to give it a two days' dressing with "Dental Pepsine." It may be my fancy, but it has always seemed to me that I accomplished thereby a very perfect *solution* of all the albuminoid matters—not only such as are contained in the canal proper, but of those in the *tubuli* as well—after which, alternate rinsings and dryings would leave the interior very pure and clean, and ready for treatment (if necessary) with aqueous solution of salycilic acid.

9. The property possessed by creosote and carbolic acid, of promptly coagulating albumen, though in my judgment so serious a bar to their employment in pulp canals (I hope no one will understand me as therefore meaning, in *abscesses*, for they unquestionably stand foremost on the list of remedies for pus-producing surfaces, only *keep them out of the nerve canals*, except as a *dernier résort*), render them especially valuable for lining cavities before introducing the gold, and in this I most decidedly take issue with those who make the sweeping assertion that they are of no possible value in such employment, or that they may produce such irritation of the pulp as to occasion its death. Of the former hypothesis I will speak in a moment; as to the latter, for very many years of exclusively "operative" practice I have pursued this method in practically every cavity, and have yet to see the first dead pulp which, by *any stretch of imagination*, could be ascribed to it; and it seems to me that to call dangerous to the pulp an agent that, in so continuous employment, as in every case for years has never yet had such untoward effect, savors much more strongly of the *transcendental* than the *residental*. With the questions of their value for the reduction of the sensibility of dentine previous to excavating, or for the arrest of decay under a stopping by "hardening" it or for "destroying the bacteria," or what not, I have nothing to do. I do not use them for any such purposes. For sensitive dentine I have more faith in a keen excavator, and a skillful and rapid hand, that makes every cut one of value, than I have in *any* medication—except such, indeed, as is applied simply to neutralize acid conditions, or unless temporary stoppings may be so denominated; indeed, it has always seemed to me that these applications, besides having very much of the nature of "puttering," were, at their best, but the *substitution of one hurt for another*. As to their being a specific against decay it seems unquestionable, to my mind, that if decay crops out at the margins of even perfect fillings, it will surely afterward proceed, whether saturated with creosote or not; whereas, if left in the bottom of a cavity and *hermetically* sealed with a stopping, it seems equally certain that it will *not* afterward proceed, whether saturated with creosote or not.

The use to which I put creosote and carbolic acid in a cavity, is to produce such a condition as shall lessen the effects of thermal changes after the gold shall have been introduced. With the cavity perfectly dry after excavating, I place in it a drop of either of these agents to remain two or three minutes, while I turn to prepare the gold intended for its reception. When the slight hurt of the application *has ceased*, not before, I proceed to dry and fill the cavity. I feel that I have thus coagulated the contents of the dentinal tubuli for a trifling depth, and so secured a non-conducting head—so to speak—to the contents of every tubule which leads from the filling to the pulp, and made, thereby, a more perfect non-conducting lining to every part of the cavity than could be secured by any other means, and that, too, without using up my cavity depth or holding points, as would have been done by a more tangible capping. I *know* that I have done present good by the fact of the drying out *after* the application being painless, as also will be the packing of the gold ; whereas, the mere drying out *before* the application was exceedingly painful. The produced condition is not an *absolutely* non-conducting one, truly; but is sufficiently so for the great comfort of the patient ; and it also tends, by greatly diminishing the shocks of thermal changes, to assist Dame Nature (by the negative process of removing obstacles so far as may be,) to reassert herself and restore the parts to as nearly normal a condition as would be possible under a gold stopping. I may here instance an item of personal experience which may be of interest in this connection : Some ten or twelve years since I had three gold stoppings inserted in as many of my inferior molars, and by three different operators ; the cavities were extraordinarily alike in every particular, being very large, but shallow, and it seemed to me, with a living *soul* in each. Two were lined with creosote at my request, and I have never since particularly noticed that they existed ; but in regard to the third, the gentleman who filled it declared so strongly that my suggestion was a mere fancy (of Dr. Atkinson's, I think he said), was all nonsense, etc., that, being many years his junior, I deferred to his age, and did not insist upon its application ; the event, however, proved him to have been entirely incorrect in the matter, as I was obliged for years to "engineer" all hot and cold substances past and around that tooth, because of its great sensitiveness to them, and endured much sorrow and tribulation when I accidentally or carelessly "lapsed" during that time.

10. I have always been at a loss to account for the very extensive employment of myrrh which obtains for tooth powders and mouth washes and *as* a mouth wash, in the form of "tinct. of myrrh." Being a resin, and dissolved in alcohol, it is precipitated instantly it comes into contact with the fluids of the mouth, and the fine insoluble precipitate collects about the necks of the teeth, insinuating itself under the edges of the gums, making great havoc with them, and eventually with the teeth—such harm, many times, outweighing all the healing qualities that may be possessed by itself and the alcohol besides. In my own practice it is tabooed, precisely as charcoal would be, it being, to my mind, as entirely inadmissible for any employment in the mouth as the charcoal and for the same principal reason, its total insolubility in any fluids resi-

dent in the buccal cavity. It seems hardly necessary to speak of its use in tooth powders—the gum is deliberately put into *such* already precipitated !

11. For temporary dressings or trial stoppings in abscessed teeth, or in the cases frequently occurring where it is deemed expedient to postpone to the next sitting the permanent stopping of a very large cavity, I am accustomed to filling the cavity nearly full with cotton, and placing over it a facing of Hill's stopping. All-sufficient hold for the temporary requirements of the stopping may be easily obtained at the sides. This produces as perfect a cavity sealing, for the time being, as solid Hill's stopping—a quality which neither cotton, saturated with the untidy *sandarach* or the fleeting *wax*, can be depended upon to possess. It is also very easily and quickly removed; in which respect it is far superior to either the *solid* gutta-percha or sandarach on cotton. Indeed there will no doubt recur, to many who have used this latter, instances in which it has required all their skill and ingenuity to remove the large hard mass—though it was loose in the cavity—without breaking out the side walls of the tooth.

12. Whenever blood shall have gotten into a cavity after its preparation it should be *washed* out before the introduction of the gold, with *e. g.*, a little pellet of spunk, saturated with warm water; to simply dry it out will surely occasion after regret; as, although this may remove the present appearance of discoloration, the oxidation of the slight amount of blood left will, after a time, show a dark stain through the enamel, giving to the whole much the appearance of a leaky stopping. Much less should tannin be used to stop the bleeding, as this acid is one of the mordants, and sets the coloring matters of the blood; in fact, forming, with the iron in the latter, tannate of iron (ink) a stain not easily eradicated.

13. I deem it prudent, in my own practice, to *always* look carefully at the rubber dam immediately upon its removal after an operation, to be certain that it is *all there*, as, however much it may have been torn or punctured, its resilience is such as that, if held or laid flat, all torn parts will readjust themselves to their proper positions in respect to each other, and the fact of a missing piece, however small, be readily known; as also, of course, by noting its place on the dam, where to look for it in the mouth. And although a patient will usually point out the fact of a piece having been left between the teeth, if such *be* the case, it is obviously not so *certain* a dependence as to examine the dam—and I have known such inadvertently-left bits of rubber to accomplish serious harm.

14. I have to suggest a method which I sometimes employ with Hill's stopping, that may be of value to those who entertain the belief that this material cannot be so applied as to exclude moisture. It is simply to saturate the *perfectly* dried walls of the cavity with chloroform, and, while

still wet, to paint them with a thin solution of Hill's stopping in chloroform, evaporating the latter perfectly, and packing the cavity carefully with warmed pieces of the stopping. I have long used this method, and with very excellent results, though my employment of it has been especially directed to very sensitive cavities, my object being to save the exquisitely sensitive surface the shock of the heated stopping applied *directly* to it, and also to secure the *positive* obtunding effect of the chloroform. I wish to say just here that I most decidedly antagonize the proposition recently so *absolutely* advanced, that gutta-percha stoppings *cannot* be so inserted as that they will not leak ! That they usually *are* not is another hypothesis, and a possibly admissible one, inasmuch as the usual and recommended mode of insertion is to heat a single piece of the material and crowd it into the cavity, crowding out the excess, moulding it while warm, so that, thrusting it in at one side of the cavity forces it correspondingly out at the other—a course that can be fully depended upon to effectually destroy any proper adaptation to the walls—and finally completing the delicate (?) operation by trimming it, while still soft and yielding, with a thick instrument, warmed only sufficiently to drag the yielding mass back and forth as it is trimmed, and so pull it away from the walls and edges, even if it had before been perfectly adapted to them. *Per contra*, the cavity having been made *very* dry, a piece, well warmed, should be placed in one side of the cavity, condensed properly into *that* place, *held against any movement after it is once so adapted*, and care taken that no such extra pressure be brought to bear upon any new pellet, as it is added, as shall move from their *packed adaptation* the portions which have gone before. In most cavities, and with proper care in packing, there need be no necessity for trimming, as there will be no excess, and it will only remain to carefully burnish the surface smooth. If, however, there be such necessity, the stopping should be cooled, and then trimmed with a thin, burnished-surface instrument, made so hot that it shall pass over the surface and cut off the excess, without heating the body of the stopping; if more than one cut be necessary, being *very* certain that none has remained upon the instrument to ruin the whole by dragging the surface, and then, if needful, carefully making certain of the extreme edges by means of a round cold burnisher.

I firmly and determinedly believe that such a stopping will *perfectly* exclude moisture, *all* assertions to the contrary notwithstanding, and such belief is made reasonable certainty by the fact that, in the removal of such stoppings, the material does not leave the walls easily, and I am oftentimes somewhat annoyed by being obliged to "whittle" the walls clear of the layer that is in juxtaposition to them, so perfect is the adhesion.

15. In placing large amalgam stoppings, the tendency of the mass to contract in hardening, or, what would produce the same effect in a stop-

ping, its inclination toward the assumption of a globular form, so tending to pull the material to a greater or less extent away from perfect contact with the walls and edges, I combat, and I think render almost *nil* in one of two ways, using either, according to its applicability to the cavity to be filled, and of course *superadded* to all usual precautions, as employing the material dry, etc. One is to fill only next the walls at the first sitting, leaving the centre free, and to be filled with *any* easily removable material which can be depended upon to retain its form *inflexibly*, until the edges shall have perfectly hardened, it then being removed and its place supplied with amalgam, thereby completing the insertion, the polishing to be done afterwards. The other is to supply as much as possible of the *body* of the stopping in *one single piece*, with a cake of the same *already hardened* (*i. e.*, from a previous using or otherwise,) the effect of which is at once seen to be that, in consequence of the great central bulk of the stopping having been already "contracted" or "globularized," or what not, security is had against those predilections as to the *mass* of the stopping, while as to the new material at the edges the security comes from the fact that the whole central part is hard and unyielding, and the entire amount of pulling away must consequently be confined to the shrinkage upon itself of this strip around the edges—a matter of practically no moment. My method, as to details, is first to pack the sides and floor of the cavity, then to rub a slight coating of mercury over the back of the hard piece which is to occupy the centre, pack a little thickness of the new material upon this, shape its "bed" in the cavity to correspond, and then carefully settle it into its place, after which the edges may be proceeded with. The results of this practice with me have been *exceedingly* gratifying.

16. There is scarcely a question that the two especially prolific causes, among reputable operators, of failure in gold stoppings (speaking, of course, of controllable failures, and not of the inroads of disease, nor of the destruction caused by careless or slovenly patients) are *imperfect filling at the cervical margins of approximal cavities*, and *the leaving, or making, of sharp angles in the formation of cavities* in general, to be, at the best, but imperfectly filled and to afterward form centres for new decay. This bit of wise counsel was given me by one of my preceptors many years ago, when I was just beginning to creep, professionally: "My boy, give all the moments you can spare during an operation to cervical edges; you'll never find that you've spent unnecessary time upon them." This was long years before the advent of the rubber dam, and when, in the stopping of approximal cavities, it was necessary to employ *every moment* to advantage. My good old friend Dr. George E. Hawes used to say, "Let me examine the cervical margin of a filling and I don't want to see the rest." I feel that the two maxims can scarcely be too often urged and *reiterated*: "Round the angles of your cavities," that they may be per-

fectly filled, and, "Pay *diligent court* to cervical margins," that their neutrality at least may be counted on, if not their friendship, in our battle with decay and disease, that they shall not *entertain* our foes if they do not turn them away; and of all things do not, by slight and neglect, leave the gate of our defenses wide open and unguarded to the very citadel, for the unopposed pouring thereinto of our most destroying enemies.

17. I had purposed offering a few thoughts upon the tendency at the present time to over-medication in our profession, while that of the most advanced of our brethren in the medical profession is very pronouncedly in the opposite direction, and with more and more of dependence upon the *vis medicatrix naturæ*, but the length of this article bids me stop now. I may merely say, however, that I am often reminded of the grim old epitaph :

> "I was well—
> I wished to be better—
> I took physic—
> And here I am."

DISCUSSION.

Dr. Dwinelle: Dr. Northrop's case of sympathy between the uterus and the oral tissues reminds me of a case of reflex sympathetic action which occurred in my own practice. A lady came to me having trouble with her left superior first bicuspid. Of this tooth one cusp only, the outer, was remaining, the other part having become decayed, and broken off. The decay, I found, extended below the gum, and the nerve was dead and exposed. I took out a portion of the dead nerve, treated the nerve canal with (I think) carbolic acid, and sealed it up. The patient appointed to return the next day, but did not do so until several months had passed. She then informed me that the sealing had come out, and the tooth was aching badly. I presumed she was correct as to location of the pain, and accordingly treated the tooth again and sealed it. The next day she stated that her left superior lateral was very sore, loose, and aching. I soon satisfied myself that the bicuspid was not now, if it ever had been, the seat of pain ; but that the lateral was the real offender. Inflammation existed here, and I treated the tooth with the usual remedies. Still the symptoms increased in severity; and I finally almost came to the conclusion to trephine the tooth and remove its nerve. But, the patient being at the time in delicate health, I resorted to systemic treatment for reducing the general febrile condition, expecting to afterward remove the dead pulp. But when the time came I could not reconcile myself to the use of the drill. Something, I know not what, perhaps instinct, kept me from doing so. I resorted to poultices, and the matter came to a head and discharged freely between the cuspid and lateral. It afterward became necessary to lance on the lingual wall, and finally the matter burrowed its way on the left side along the palatine arch to the velum, forming a pocket from which came a free discharge. Ultimately it healed; and my disinclination for destroying the nerve of the tooth was confirmed, for it is now living, and as well as any in the jaw. I conclude that there existed some disturbance between the two plates of bone, distinct from the teeth; and that the lateral, although seemingly involved, had little or nothing to do with the trouble, being the subject only of reflex sympathetic action. The bicuspid, subsequently becoming diseased, was removed.

DR. GEORGE A. MILLS (*Brooklyn, N. Y.*) : Dr. Hodson has made a valuable suggestion as to the removal of the rubber dam from the teeth. Several years ago I assisted a friend in introducing a troublesome and expensive filling, the rubber dam being used in the operation. The next day the patient advised my friend of an uncomfortable feeling of the tooth operated upon. It was considered a minor matter, and treated locally. On the third day, as the trouble was increasing, I examined the tooth carefully, making all the usual tests. There was a curious inflammatory condition, similar to that where the gum grows up over a tooth. I could not discover any reasonable cause for the difficulty. The difficulty increased, finally, to such a degree that the patient went elsewhere and had the tooth extracted. The operator who extracted it said there was a rim of tartar around it ; but the patient speedily discovered that the "rim of tartar" was in reality a rubber ring, part of the dam used in filling the tooth. It was about the one-sixteenth of an inch in width, and I have no doubt it came from the dam.

DR. SANFORD G. PERRY : I can reinforce Dr. Mill's statement, because I have seen two or three cases in which considerable trouble has come from the same cause.

DR. DWINELLE: Often, after stripping off the dam suddenly, and examining the hole you punched, you will find it has increased considerably in size. We are all familiar with the method of forming holes in the dam by stretching it over the round end of an excavator and touching it, near the end, with a sharp instrument. A sudden stretching over such an apparatus will also produce a round hole, a circular portion of the dam being detached from the body of the material. I believe there is a case, recorded in the *American Journal of Dental Science*, in which a rubber regulating ring, by working upward on the tapering root, ultimately denuded that root of its periosteum and ejected the tooth from the jaw. I think Dr. McQuillen reported such a case in the *Cosmos*. I have known two or three such cases, where the amount of inflammation developed was out of all proportion to the size of the rings which caused it

DR. BROCKWAY: This suggestion is not the least valuable among the many which Dr. Hodson has given us. There is a very simple method of avoiding the difficulty—soaping the tooth before removing the dam. I keep at hand a little bottle of soap solution and a brush for this purpose.

Dr. George Allen (*New York*): I would like to present you a short account of a case which I have lately treated, and will ask Dr. Hodson to state, as much in detail as possible, the premonitory symptoms which brought him to my chair.

Dr. Hodson: The whole premonitory symptoms are comprised in the fact that the tooth, at times, gave slight pain to the touch; sometimes at night, sometimes in the morning; and again, somwhat extended intervals of no soreness. The conclusion finally arrived at was, that there was probably a pulp-stone, or some deposition of secondary dentine, going on in the interior of the tooth. Fears of excessive deposition or discoloration led to the determination to open the tooth. Dr. Allen did so, commencing in a small filled cavity in its proximal surface, and exposing the pulp, which he destroyed. The tooth was very sore, and the gum purple over the root for about a week afterward, when an opening appeared over the root, and about one-quarter of an inch above the margin of the gum. I noticed this process beginning in a very small point which finally became an opening which seemed to extend to the interior of the root. The natural conclusion was, that the drill had crossed the pulp canal and wholly penetrated the root; but this was found not to be the case.

Dr. Allen: The symptoms which Dr. Hodson has described, and others which he has forgotten, induced me to believe that there was in that tooth either a formation of pulp-stones or pulpitis. I saw him several times before I decided to destroy the pulp and fill the chamber, and only when there appeared to be no hope of saving the pulp alive. The filling I took out was a small and very perfect one, with nothing about it to indicate the cause of the trouble. The floor of the cavity was soft, and I cut about two-thirds of the distance to the pulp before the pain became acute.

Two years ago I ceased the use of arsenic for destroying pulps. Since then I have used only chromic acid. This is the only case I have had in which bad effects seemed to follow its use. I have never had discoloration succeeding it, nor periostitis. I first used it in the case of a patient who absolutely refused to permit the employment of arsenic, and whose strength was insufficient for cold steel. In Dr. Hodson's case I applied the acid, after having exposed the pulp, and saw no difference between its action there and in my other cases. It acted kindly and rapidly. After bringing the pulp fully under the action of the acid, I dismissed him, leaving a small crystal of acid in the pulp chamber. The next morning I found the tooth discolored, with much periostitis about the root. One little point on the gum, though not inflamed, was so especially red as to be distinguished by its color from the rest of the gum. There was then no opening at this point, and no discharge. It appeared simply a case of periostitis; and yet I could not account for the inflammation or the discoloration. As you may readily imagine, I was much disturbed. This condition continued, I think, for about a week. The dead pulp was removed, and the tooth treated as I ordinarily treat such teeth, the inflammation subsiding. A day or two afterward I received a kind note from the doctor, in which he stated that my drill had passed through the root to the periosteum beyond, making an opening which had allowed the acid to act directly on the cementum, causing discoloration and inflammation. I immediately went to see him; and, certainly, everything appeared to bear out his view of the case. I asked him to my office, and there a close examination of the opening in the gum revealed such a condition of things that I sent for Dr. Palmer to confirm my view. I told Dr. Hodson then that the tooth was fractured on a line upward and inward from the opening, and that a little piece of the root which had broken out, being directly in the line of the drill-hole, had caused Dr. Hodson to believe that the drill had penetrated the root at that point. Dr. Palmer acquiesced in this view, which Dr. Hodson also finally accepted. Since then several have seen the case, and I believe the fracture is an undoubted fact. I cannot account for it, nor can Dr. Hodson; yet how it could have occurred without a sharp blow we cannot divine. The whole trouble, however, is accounted for by the fracture. The rapid discoloration I explain by the fact that the fracture exposed a large number of the tubuli, at their larger extremities, to the access of the hæmatine. At present the tooth is filled with gutta-percha, and tied to prevent motion and consequent irritation. The line of the foramen prevents my putting in a threaded wire with a nut on the end, for the nut would then necessarily come on the outer face of the tooth, so that I have decided to insert a gold wire bent to the shape of the pulp canal, and extending from apex to crown, and to fill around it with osteo-plastic.

Dr. Jarvie: How long had the tooth been sensitive up to the time you destroyed the pulp?

Dr. Allen: About five or six months. The fracture began about one-eighth of an inch above the margin of the gum. The tooth was perfectly white and solid.

Dr. Tenison: Had it fractured all the way in the root?

Dr. Allen: Yes, and completely through it.

Dr. Bogue: I have just had my finger on a case of fracture in the mouth of Dr. Rich. Will he tell us about it?

Dr. Rich: About twenty-five years ago I began to experience, occasionally, a painful sensation in my right superior first bicuspid. Examination did not discover any perceptible decay about it, the tooth appearing to be perfectly sound. During the two or three years that followed the first appearance of this unaccountable pain, although there was always an uneasy feeling about the tooth, it was not continuously painful; but sometimes I suffered so much acute pain from it that I thought I would be obliged to part with it. After these conditions had existed about the time I have mentioned, very acute inflammation occurred, lasting several days, and then there were unmistakable indications that the pulp was dead. Upon making a careful examination for the purpose of opening into the cavity and removing the dead pulp, it was discovered that the inside cusp was detached from the body of the tooth, the fracture extending nearly up to the point of the root and involving the pulp cavity. That this fracture had existed from the commencement of the difficulty, was surmised from the sensations that were produced when the fractured part was moved, they being identical with those experienced at the early stages of the trouble. An orifice was made in the labial surface of the tooth and the pulp removed. The conditions were such that the pulp cavity could not be filled, and it was left open, and has remained so ever since. Some ten years ago the inside cusp broke off above the gum, leaving a portion of the fractured part of the root protruding from the gum. I can always produce pain by pressing upon this part, either in the direction of the main portion of the tooth or away from it; but I cannot produce pain by pressing upon the main portion of the tooth in any way. It never gives me any trouble except when I press upon the inside portion.

Dr. Frank Abbott (*New York*): On two former occasions I have presented before this Society the case of necrosis of both the upper and lower jaws of a little girl two and a half years of age. On the occasion of my first presentation of the case, I stated that I feared that the antrum, upon the right side, was involved. Upon further examination, I found that I was correct in my suspicions; and not only was its floor destroyed, but the wall of the nares. I further found that pus was present in small quantity in the neighborhood, which did not readily find egress; this eventually worked its way through the naso-maxillary fissure, and was discharged upon the side of the nose.

I have with me the teeth and pieces of bone removed from the lower jaw, principally (very little having been removed from the upper), the quantity of which will afford an idea of the extent of the disease. The child is now very nearly well. She has grown very much indeed, and has the appearance of a very robust child. The treatment consisted of syrup of iodide of iron and syrup of lacto-phosphate of lime internally, given alternate weeks, and a weak solution of carbolic acid locally, with the removal of the spicula of bone as they became loose.

Dr. St. G. Elliott: I would like to report two cases which came into an office on Staten Island, and were brought to me. The first, a child, had invested his means in a tin "putty-blower," and while the instrument was occupying the normal position in such cases, had fallen forward. The result was that the tin tube was forced backward obliquely through the soft palate and pharyngeal wall to the spinal column, making a peculiar circular incision, but not bringing away any of the tissues. The soft palate, though cut down to the lower margin, had lost no substance, and was hanging in the mouth. With a needle and the ordinary forceps (all the instruments I could find), I sewed up the wound in the palate. The next day the child had pulled out the stitches. I again sewed the wound, and in four days from that time it was perfectly healed, leaving no bad effect except the scar.

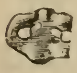
The second case was one of an osseous growth in the nose. It had been examined by several surgeons, the question being whether the operation for its removal should be through the cheek, or from the angle of the mouth. Dr. Derby solved the problem by cutting out the growth with a dental engine.

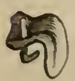
The following communication, accompanying specimens of platina caps for soft fillings, was next read by the Secretary:

METALLIC CAPS FOR GUTTA-PERCHA FILLINGS.

BY DR. J. EDWARD LINE, M.D.S., D.D.S., ROCHESTER, N. Y.

About six months ago I was called upon by a lady to fill a badly decayed lower bicuspid. The pulp cavity was empty, the dentine of the crown completely gone, the enamel of both the mesial and distal walls broken away—in short, nothing was left of the crown but the buccal and lingual plates of enamel. I filled the root with oxychloride of zinc. What to fill the crown with was the question. It had been filled repeatedly with some one of the mineral cements, also with Hill's stopping; but in every instance the material gave out after a very brief period of usefulness. Gold was not to be thought of; amalgam she would not have—would much rather lose the tooth. It occurred to me that a metallic cap might be fitted to the crown. Believing this practicable, I filled the crown with Hill's stopping, dismissed the case temporarily, and, in the mean time, worked out the little device herein described, and which, in this case at least, seems likely to last as long as the tooth itself.





The device consists of a thin plate of platinum, to the under side of which is attached a fine wire hook or loop, or from the under side of which project two or more curved lugs punched from the body of the plate.

Ordinarily these caps can be made by means of flat and round nose-pliers; but where it is desired to restore the contour of the tooth, the lost portion must first be restored in wax, an impression taken, dies made and plate swaged. But this is unnecessary unless a very nice piece of work is wanted. A better plan is to swage a quantity of caps on dies of well-formed molars and other teeth, and keep them on hand. As cases present, the caps can be trimmed to fit cavities of any size and shape.

After a cap has been trimmed to the outline of the cavity to be filled, a hole is drilled through it, a platinum wire, with a hook or loop at the end, put through from the under side, a little solder placed on the plate near the loop, and the whole held in a flame until the solder flows. The wire on the upper side, and by which the cap is handled, is then cut off about one-sixteenth of an inch from the plate. Or, as I prefer for crown cavities in molars, and large cavities generally that are out of sight, lay the plate on a piece of lead, and with a suitably-formed instrument punch two or more lugs from or near the centre. Bend the lugs in such manner that, when applied, the cap will take firm hold of the filling. This latter kind is of use principally in molars, and is more likely to be in demand than the hook or loop kind, because less time is consumed in construction. The openings left in the plate after the lugs have been punched from it do not in any way detract from the utility of the appliance.

To apply it, fill the cavity with any form of gutta-percha, seize the cap by the wire that projects from the upper surface (or, if it has lugs, by inserting the points of a pair of plugging-pliers into the holes), heat in a flame, and sink it into the filling. It may not go quite into place—may need some adjusting. This is easily accomplished by heating a burnisher, or other blunt instrument, and holding it in contact with the cap until the filling is softened, when the appliance may be readily moved into its proper place.

I find these caps useful in simple crown cavities in temporary molars, and in compound cavities that involve more or less of the grinding surface. They are also useful in similar cavities in permanent molars, particularly where the dentist wishes to favor the formation of new dentine. In not a few cases of this kind uncapped gutta-percha fillings grind out, the owners of the teeth defer their call to have the filling renewed, and in a short time the work of weeks, perhaps months, is completely undone. On the other hand, capped fillings endure for months, and—judging from the limited experience we are obliged to record—may last for years, and that without a single renewal. We have used them in other than molar and bicuspid cavities, but not to any great extent.

Dr. L. D. Shepard, of Boston, presented a model of the mouth of a man who had long been in the habit of smoking a clay pipe. The teeth, both above and below, where the pipe had been held, were worn away so that a circular opening was formed, large enough to allow an ordinary lead pencil to slip in freely.

Adjourned.

Society Communications.

NEW-FORMATION OF EPITHELIUM.

BY WILLIAM HERBERT ROLLINS, BOSTON, MASS.

The living doctrines can be divided into two general classes:

1st. Development of epithelium from cells of internal or external germinal layers.

2d. Development of epithelium from cells of any of the embryonic layers, directly, or through the medium of a blastema, the product of any of these three layers.

The first seems to accord with what is recognized by the majority of embryologists as the most probable method of development of the ovum, that after the formation of the layers in the blastoderm, elements of the middle layer cannot develop into tissues of either the external or internal layers.

His says there are but two layers—the archiblast, arising from the germ disk ; the parablast, derived from the white yolk.

Stricker states that the observations upon which this theory is founded can be explained so as to support the first theory.

Greater elaboration here would be out of place. Next will be mentioned briefly the doctrines held by observers on the regeneration or new-formation of epithelium.

Billroth is so firmly convinced that epithelium arises only from epithelium, as to say that those who hold another view must be mistaken. He thinks epitheliomas never arise from bones.

Waldeyer says: After the formation of the three embryonic layers, the cells of the middle layer cannot produce epithelium.

Thiersh thinks epithelium arises from epithelium alone ; that in wounds the new epithelium comes from undestroyed remains of the strat. malpig., or from epithelium at the borders of the wound.

Hoffmann says : On the cornea the new epithelium arises as buds from the peripheral epithelial cells.

Heiberg is of the same opinion. He states that the projections of the epithelial cells have slow ameboid movements.

G. F. Wadsworth and Eberth say that the new epithelium, in their experiments on frogs' corneas, came from epithelial cells of the periphery, growing larger, and dividing both into nuclei and surrounding protoplasm.

Wagner is so convinced that epithelium arises only from epithelium, as to use this as part of his definition of epithelium.

Rindfleisch says he has observed a new formation of epithelium in the centre of a wound where participation of the peripheral epithelium was impossible.

Arnold, as the result of his investigations on the cornea, says the new epithelium arises from a blastema which comes from the epithelium at the edges and from the connective tissue.

The difficulty of making investigations on the new-formation of epithelium, lies in the anatomical character of the tissues which have been used. It has been impossible to prove that the new epithelium did not arise from pre-existing epithelium.

If an epithelium is found on some tissue where none was recognized as existing, where, from the anatomical position of the tissue, participation of epithelium in the new-formation was not possible, then it seems as if it might with confidence be said that epithelium could arise from the middle germinal layer, provided our anatomical knowledge of that tissue upon which the epithelium was found is correct.

Such a condition seems to be present in the dental pulps. These are separated from any tissue now acknowledged as epithelium by the whole length of the periosteums of their roots, the nearest epithelium being that covering the gum of the oral cavity.

In some tumors (so-called hypertrophies), which arise from the dental pulps (in almost every case from those of the first permanent molars), there can be found a distinct epithelium covering the surface.

If this observation is correct, must we not deny the truth of the almost universally held opinion of epithelium arising only from epithelium, or of the universally held opinion of dentine being a derivative of the connective-tissue group?

There exists no need for giving the authorities in favor of the dentine being a product of the middle germinal layer, for all admit this to be true.

Against this universal opinion I can at present mention only—

1st. In *triton cristatus* the teeth seem to be developed in the centre of a mass of epithelium.

2d. It has been shown that all animals have a dipping down of the oral epithelium into the connective-tissue, yet all animals do not have enamel-clad teeth.

If one is inclined to think the dentine is a product of the external germinal layer, then this dipping of the epithelium where it is not wanted for the production of enamel will be significant.

3d. In exposure of the tooth, if the surface has been destroyed, true dentine is not formed over the exposed surface.

This may be explained by saying that the odontoblast cells, which form an epithelium-like covering to the well developed connective-tissue of the pulp, having been destroyed, there are no cells remaining which can produce true dentine.

4th. In normal absorption of temporary teeth, the portion of the dentine last to yield is that in contact with the odontoblast layer. This may indicate a possible difference in origin, whereby the odontoblasts are incapable of performing the function of osteoclasts.

Some support is given to this view by this: while pathological absorption is common upon the cement of the roots, even when the pulp is alive, yet it is not seen in the dentine where this is in contact with the odontoblasts.

Summary.—In certain tumors of the dental pulps there seems to be an epithelium covering the surface.

From the situation of these organs, participation of any epithelium now recognized as such seems to be excluded. If the observations are correct, either epithelium can come from the middle germinal layer, or dentine is a product of the external germinal layer.

Society Notices.

CORRECTIONS OF THE LIST OF MEMBERS.

The following corrections of the list of members of the Society published in the last number of the magazine, have been received.

Bödecker, C. F. M., D.D.S. ......37 West 45th St., New York City.
Brackett, C.A., D.M.D ....113 Thames St., Newport, R.I.
Clowes, J. W., D.D.S ....597 Fifth Ave., New York City.
Cravens, Junius E., D.D.S....106 N. Meridian St., Indianapolis, Ind.
Dodge, Henry N., M.D., D.D.S.......15 West 20th St., New York City.
Francis, C. E., D.D.S., M.D.S......33 West 37th St., New York City.
Hall, Chas. O., D.D.S ....1 Place Messina, Nice, France.
Harris, E. N., D.M.D ....150 Tremont St., Boston, Mass.
Hoag, Wm., M.D., D.D.S............11 East 43d St., New York City.
McDowell, S. A., D.D.S...5 Marienstrasse, Frankfort á M., Germany.
Miller, Chas., M.D.S....... ...331 Madison Ave., New York City.
Parker, David M., M.D.......... ...132 Boylston St., Boston, Mass.
Parmele, G. L., M.D., D.M.D.............25 Pratt St., Hartford Conn.
Roy, E. G., D.D.S................215 West 34th St., New York City.
Tenison, W. D., D.D.S. ....45 East 28th St., New York City.
Van Marter, J. G., D.D.S...........................Florence, Italy.
Wadsworth, T. A., D.D.S. ....42 West 33d St., New York City.
I. F. Wardwell, D.D.S............................Stamford, Conn.
Woolfolk, T. L., D.D.S...........10 East 34th St., New York City.

The Secretary would repeat the request published at the head of the list in the last number, that members give him notice of any inaccuracies or omissions in that list, in order that they may be corrected.

A. H. Brockway, M.D.S., *Cor. Sec.*

TO ASSOCIATE MEMBERS.

As several of the associate members have sent subscriptions for this publication, the Corresponding Secretary takes this means of notifying all members that they will receive the magazine free, as one of the privileges of their membership, in lieu of the bound yearly volumes heretofore distributed.

A. H. Brockway, *Cor. Sec.*

RESOLUTIONS ON GARBLED REPORTS OF THE SOCIETY MEETINGS.

Passed at the meeting of April 16th, 1878.

Dr. A. L. Northrop offered the following remarks and resolutions:

"Dr. Hill's presentation of the stenographer's notes shows that the reports of our November meeting, as published in several of the journals, are very incorrect, and do us and our visitors great injustice. Therefore I ask that the Society, as such, expresses its sense of these facts, and I offer this resolution:

Resolved, That the New York Odontological Society views with disfavor the publication of all unauthorized or irregular reports of its transactions, since such do not present a just or correct view of the Society's proceedings, and therefore tend to the injury of the Society and of the writers of the reports in question.

Dr. C. E. Francis: In seconding the motion, I would say that reports of the kind of which we have just heard tend to throw ridicule upon the members of the Society, and also to discourage gentlemen from participating in the discussions.

Dr. E. A. Bogue: I would offer an amendment to the resolution, as follows: That the journals henceforward be requested to make the Dental and Oral Science Magazine the only source from which to obtain reports of the proceedings of this Society.

The amendment being accepted by Dr. Northrop, and thus becoming part of the original resolution, the whole was adopted, as above, unanimously.

Society Correspondence.

THE NEW DEPARTURE.

The first number of the magazine is at hand, and we like it very much because it reflects the present state of high-toned dentistry. But we are getting the impression, here in the West, that we are being heavily *bull-dozed* by the oriental amalgam plasterers. Prof. Chase, of St. Louis, tells us that gold alloy, or gold and platina, is a splendid thing for preserving teeth; for he has tested it by several years of experience. Next he tells us that gold and platina are superior conductors of *electricity*, exciting a current which generates *acids* which rapidly destroy the teeth ! For he has also proved this by sundry experiments. Prof. Flagg, of Philadelphia, tells us that Townsend's amalgam of tin and silver is the thing, *par excellence*, for saving teeth. A Philadelphia manufacturer tells us that his amalgam is the *ne plus ultra* for the same purpose, because of its great *hardness;* and Dr. Flagg supports this, although he has also said that tin is a good saving material because it is *soft.*

Please inform the *bulldozers*, for me, that the lingual surfaces of teeth rarely decay, because they are kept clean by the tongue; and that the buccal surfaces decay whenever the oral secretions are vitiated or become abnormal, acid or viscid, and no amount of filing, or filling with gold, amalgam, or any other material, will save them from destruction unless they are plugged pathologically. Pathological plugs alone can be relied upon to save such teeth as are rapidly decaying on the buccal surfaces.

A. P. BURRUS, *Jonesville, Wis.*

[The editor begs to suggest to Dr. Burrus that the Odontological Society, as such, does not take sides, or recommend any special modes of procedure, on any scientific question; but is very glad to give opportunity for the presentation and discussion of *all* matters having scientific or professional interest, be the presenters "plasterers," "introducers," or what not. If the Doctor will give us his views on "pathological plugs," we shall be happy to afford him a like opportunity.—ED.]

THE CASE OF THE FRACTURED TOOTH.

The day after presenting Dr. Hodson's case to the Society at its March meeting, he called at my office by appointment. It may be here said that Dr. H. had been desirous of having the tooth filled with as little delay as possible, but had been put off from day to day simply because I could not feel certain as to the condition of the pulp canal. There was a roughness and an undefinable character in the touch of the probe to the surface of the canal, that left a doubt in the mind as to whether all was known of the condition of the parts. The probe certainly touched a crack; but it also touched more than a crack, and hence the unwillingness to proceed. The solution of the problem was, however, now near at hand.

On looking at the opening in the gum, the alveolar process looked a trifle out of place, and on touching it with an instrument was found to be loose, and evidently necrosed. Not knowing how much of the bone was involved, and being pressed for time, another appointment was made for the following day. The appointment was kept, and the bone removed—a small pair of pincers supplying all the force necessary—the opening in the gum, about an eighth of an inch in diameter, allowing it quite readily to pass through. The piece of bone removed was irregular in outline, but white and hard, and looked more like a splinter that had been broken off a healthy bone there than one that had been separated by disease. The piece removed comprised all that was dead. The surrounding bone was healthy and strong.

Now comes the strange part of the story. The splinter of bone removed had on its under surface a knob or boss—not adhering to it, but forming a part of it, in shape like a hemisphere—raised from the surface of the bone about two thirty-seconds of an inch, and in diameter about three thirty-seconds of an inch. This boss, or rounded bony nodule, fitted into a corresponding depression in the root of the tooth, in much the same manner that the acorn fits its cup, only more loosely, the cavity in the root being about a fourth larger than the nodule, and in depth sufficient to almost touch the pulp cavity.

Of course the root was much weakened by the cavity, and a slight blow only was necessary to crack it. In fact, the blow that did break it was so slight that Dr. H. had no knowledge of when or how it happened. Once broken, the slight irritation arising from the parts working or moving one on the other was sufficient to excite inflammation, slight at first, but gradually increasing in intensity, until it became necessary to destroy the pulp. As the mischief was entirely out of sight, there being absolutely no physical signs by which to form a diagnosis, the cause of the trouble was only made certain when the little portion of the alveolar process, with its nodular growth, was removed.

At this present writing the tooth is free from all pain or even sensitiveness. The opening in the gum remains unchanged. The color of the tooth is, however, bad. A few days after taking out the bit of bone the tooth was filled temporarily with gutta-percha, a stiff piece of gold wire having first been placed in the pulp canal, having one end adapted as closely as possible to the foramen, and the other resting in the crown and touching the superior wall of the cavity.

The mystery still remains as to the nature of the nodule. Is it a true exostosis? Was the nodule formed first, and by its growth induced absorption in that portion of the root over which it rested? Or did the cavity in the root first form, and then the nodule grow into it? Or, finally, was the cavity formed during the development of the tooth?

Before the next number of the JOURNAL is issued, a section of the nodule will be made and its microscopic character determined. How much this may help to settle the questions involved, remains to be seen. As the editor has, however, kindly offered to publish the results, with cuts to illustrate, if necessary, they will be given to the profession at that time.

GEORGE S. ALLEN.

New York, May 8th, 1878.

Communications.

To the Editor of the DENTAL AND ORAL SCIENCE MAGAZINE:

DEAR SIR: In several of the late dental journals, but notably in the March number of *Johnstons' Dental Miscellany*, and the *British Review of Dental Surgery*, there has appeared what purports to be a "Report of the Meetings of the New York Odontological Society, November 20th and 21st, 1877," in which great injustice has been done to all the gentlemen who read papers and participated in the discussions at those meetings. In regard especially to the reports of my own remarks, November 21st, I have to say that they are not only incorrect, but absolutely false, in almost every particular. To substantiate this statement I beg you will have published in your journal the official stenographic notes of my remarks on that day, making only such changes in them as may be absolutely necessary to correct ungrammatical or obscure phrases. By so doing you will very much oblige your friend,

O. E. HILL,
160 Clinton St., Brooklyn, N. Y.

April 15th, 1878.

[We take great pleasure in acceding to Dr. Hill's request, and append below the notes he asks for, corrected solely by ourselves. In the department of "Society Notices," in this number, will also be found the action of the Odontological Society on this matter, had at the meeting of the 16th April, and thus taken out of its proper order of publication for the purpose of showing the Society's estimation of literary piracy in general, and that of its own transactions in particular.—ED.]

REPORT.

DR. O. E. HILL: Mr. President: The vim is almost taken out of me. I did think, when the paper was read, that I would give the discussion a practical turn. I asked Dr. Farrar if he meant *necrosed* bone. He said he did; but as I understand the paper, nothing had been done with necrosed bone. He had been actually experimenting with living bone, as it is called in the laboratory; that is, bone which has been taken from animals recently killed. If you operate with this acid on living bone, the wonder is that you have any sediment at all at the bottoms of the bottles. It is not wonderful that you have so little, but that you have so much. Take a portion of necrosed bone and put it in acid, one to four, and keep it for four days at 100°, and it will be almost entirely dissolved. If you put living bone in the same acid solution for four days at the same heat, you will find comparatively little or no sediment in the vessel, and that the bone has lost little or none of its properties. Where is the beginning of the sulphuric acid treatment? In 1868-9, at St. George's Hospital in London, with Dr. Pollock. You will find his experiments in the London *Lancet*. He used acid from purity to a dilution of one to four. Dr. Atkinson introduced the remedy into dentistry, and pounded its use into me and all of us, until I began to experiment with it. I had seen the original article in the *Lancet*, but I had not the courage to use the remedy on its recommendation. To give this discussion a practical turn, I will relate to you a case which was in my office on Monday. A young married lady, rather delicate, who moves in the best society in the city in which I live, had an abscessed bicuspid last summer. Instead of consulting me at the time, she let it go. Three or four days ago she came into my office with several openings in the gum, on the left side between the upper eye-tooth and the first molar. The gum was blue, and indicated the presence of necrosed bone. On probing I found a large pocket in the bone at the end of the root of the first bicuspid. The tooth was so loose that when I pumped up and down in the pulp canal I was afraid I should remove it. Three days before there had been a profuse discharge, and when I pressed on the tooth the pus would still ooze out all around it. I went into the large pocket with acid, one to four—and I will say here that the ordinary or commercial acid is just as good as any other for such purposes. At least a chemist tells me so. Since then I have treated it every day with acid, one to four. The second day, through a sudden movement of the head during treatment, the syringe slipped and the acid ran down the patient's face. That acid had no more effect on the skin than so much water. It didn't mark her at all. And yet I had used one of White's glass syringes filled with the solution, which I was forcing into the pocket. In this instance, as in all such cases, I had placed cotton saturated with a solution of bicarbonate of soda around the tooth, to protect the mouth and gums from the acid solution. This morning there was not a drop of pus. I had cotton in there, and I took it out. No pus on it. It was saturated with a weak solution of aromatic acid, not for the bone, but for the soft tissues around. The other acid probably was not in the pocket twenty minutes before it was neutralized by the bone it had dissolved. If put in half water and half acid, I should expect that the eating power of the acid would be pretty much over after twenty minutes. I am sorry Dr. Farrar's paper is so little practical. I am a little sorry Dr. Atkinson was so severe. I don't mind Atkinson being severe on me, because I am not sensitive, and I will fire back the best way I can; but my friend Farrar is more sensitive than I. As to the effect of acid on necrosed bone, his experiments are not what I expected. Dr. Farrar has been making all his experiments on living bone. I have often had gentlemen tell me of the wonderful effects of aromatic acid upon necrosed bone. It really has very little effect. You may soak a piece of necrosed bone in it for a month, and the bone won't be touched. I have had such bone in it for many weeks without perceptible effect.

Editorial.

AN APOLOGY.

In the January number of this magazine, on page 68, will be found a report of the remarks of Dr. Wm. H. Atkinson on the paper of Dr. A. H. Thompson. Through a singular oversight these remarks were printed without proper preparation, and present such a mixture of incongruity and error as, we are sure, no one has attributed to Dr. Atkinson himself. We desire to offer our sincere apology to Dr. Atkinson and to our readers for this condition of things, and to assume the responsibility ourselves. The remarks, as printed, crept through our hands in the confusion created by the many and diverse labors incident to starting a new journal. We assure Dr. Atkinson and the public that no similar accident shall again occur.

Dental Selections.

A SINGULAR CASE OF ANÆSTHESIA CAUSED BY THE PAIN OF A CARIOUS TOOTH.

BY PROF. LUIGI RIBOLLA, M.C.D.

A lady, thirty years of age, weak constitution, and nervo-lymphatic temperament, had long suffered from a recurrent odontalgia caused by the caries of an inferior right molar. Last May she called upon me for advice, on account of the great increase of the pain. On examination I found the caries had reached the cavity of the pulp, which, being denuded, had begun to suppurate, and at the same time the dentine was quite sensitive to the contact of the instrument. As the tooth was solidly implanted, instead of extracting I resolved to remove the remnant of the pulp, rinse the cavity with a solution of phenate of soda, and make an application of a mixture of two parts sulphuric ether saturated with salycilic acid and one part of essential oil of peppermint. The pain at once ceased, and the dentine also became insensible to the touch, so that I proceeded immediately to fill it with tin foil.

While in the very act of putting in the filling, a new phenomenon appeared. At every pressure upon the tooth with the plugger, the patient perceived a sort of buzzing in the right ear, and when the operation was completed experienced a difficulty of hearing, and a dull pain in that ear, which compelled her for several minutes to press her hand tight against it. This symptom at length ceased, the patient was dismissed, and for three days perceived no trouble, either in the tooth or in the ear. But shortly after the pain in the ear came on again, accompanied by acute radiations into the corresponding temple, recurring every evening and not ceasing till about two in the morning. Quinine being exhibited, and chloral hydrate, after a week all pain ceased, but was succeeded by complete deafness in the ear. Considering that this new symptom must have relation to the trouble in the tooth, I resolved to extract it, and upon doing so the patient recovered her hearing as by enchantment, and from that time forward has had no pain in the ear, nor difficulty of hearing.

Examination of the tooth showed a slight exostosis at about the lower third of the root, caused, perhaps, by alveolo-dental periostitis.

That the decay of the tooth and the operation of filling it were the causes of the symptom referred to the ear there can be no doubt, inasmuch as it appeared while performing the operation and disappeared at once upon the removal of the tooth. But the how and why these things took place have, in my opinion, no such easy explanation. That caries of the teeth, by being the essential direct cause of trifacial neuralgia, may give rise to a multiplicity of sensor and motor irradiations, is a fact sufficiently well understood, and is evidenced by the hyperæsthesias of the fifth pair of cranial nerves and their ganglions and intrabulbar connections ; and as the pains in the posterior cervical region, and those of the occiput, are known, also the scapulo-clavicular intercostal and mammarial disturbances, the singings in the ear, and the dimming of the sight, as indeed numerous other facts referable to the motor sphere, and explained by the known laws of reflex action, so we must know that similar facts take place during the access of odontalgia and are of easy explanation, now that physiology has made such progress in the study of the laws regulating the functional activity and the diseased conditions of the cerebro-spinal nervous system.

In our case, however, during the paroxysm, not of a neuralgia of the trigeminus, but of a simple toothache, the rumbling in the ear, the otalgia, the deafness, did not occur; and not till after the tooth had been operated on and the pain had disappeared did the remote phenomena begin to make their appearance. Since we cannot refer them to the tooth itself, if we do not consider this fact in the literal sense of a sensitive irradition, nor yet are able to call to our aid the laws of the eccentric projection of pain, there remains to us nothing but to characterize this as anæsthesia from pain, not in the sense commonly understood, but in that of anæsthesia of a nerve, whose most intimate molecular modifications, caused by the disease in the tooth, although not giving rise to a local pain, nevertheless exercise such influence upon other connected portions of the peripheric nervous system as to produce the observed symptoms. We have no desire to enter upon the vast field of physiology; nor do we desire, moreover, to become followers of that school of physiology which seems to invade the whole body of the science of medicine, with, perhaps, small utility in its practice; but we are glad to have announced a noteworthy fact, whose most plausible interpretation seems that which we have given, not without the hope that men more competent for such investigations than we may have in their possession another datum which may, perhaps, go to show that the polymorphism of the phenomena of diseases of the cerebro-spinal nervous system cannot be so easily explained by the known laws from which arise the diseased manifestations of that most noble portion of our organism.—*Translated from "Odontologia," by Prof. T. H. Chandler.*

REFLEX AFFECTIONS DUE TO IRRITATIONS RESULTING FROM DISEASES OF THE TEETH.

BY PROF. FRANCESCO SIRLETTI.

Among the multifold neuroses are some which have a strict analogy with the affections produced by irritations of the teeth, such as epilepsy, chorea and neuralgia. These are also themselves, at times, secondary reflex affections arising from tooth troubles, and are always of difficult diagnosis, being yet hardly recognized as coming within the vast field of modern dentistry.

If we consider the fact of the intimate relations of the fifth pair with the great sympathetic by means of the ciliary, optic, sphenopalatine and sub-maxillary ganglia, this is enough to show that irritations, produced by diseases of the teeth, may occasion disturbances in the nutritive functions through the injurious influence transmitted through the ganglia in relation with the ganglion of Gasser. This, however, is not enough to determine what are the lesions of the teeth that possess this pernicious influence. And, although many writers have discussed these maladies, nevertheless they have always avoided stating what are preferably the maladies of the teeth capable of producing such disorders.

EPILEPSY.—It is well known that convulsions at the period of second dentition are not common, but yet are not to be entirely overlooked in the diseases peculiar to the eruption of the permanent teeth. Children often have epileptiform attacks at this period, which cease after the teeth are fully through the gums, as well as other serious disorders, the expulsion of the teeth being the exciting cause.

May not exostosis upon the roots of a tooth also occasion epileptic attacks? No doubt it is difficult to diagnose the fact of exostosis; yet if exostosis is accompanied by caries, the following are the symptoms in many cases; the tooth is slightly loose, painful at the least touch, very sensible to changes of temperature, and in some cases the gum falls away so as to expose the neck of the tooth. Yet these symptoms are not infrequently absent till after the patient has suffered a long time with "tic douloureux."

The spasmodic pain caused by exostosis of the root may in such cases disturb the whole nervous system, and occasion epilepsy. In this connection it will not be out of place to relate briefly the story of a case of epilepsy cured by me in a youth of sixteen, an alumnus of the Convitto di Mondragone.

This youth, of strong and sound constitution, without hereditary tendencies to the disease under consideration, two years previously had become subject to epileptic attacks, always believed to have been caused by a fall from a horse. But one day, on my visit to the scholars, this youth was brought up to have his mouth examined, as he had been but a short time in the convitto, and I found the two inferior first molars badly decayed. On interrogating him about them he informed me that for a long time he had had intermittent pains in his face and head, and that these pains always preceded the convulsions by one or two hours, but this had always been attributed to the emotions resulting from his fall. The question never had been asked if the epilepsy began before or after this accident, and the care of the mouth had also been neglected. Having fully ascertained the facts I felt sure that extraction of these teeth would cure the disease, as indeed it did.

After the extraction exostoses were found on the roots of both the teeth. The convulsions have never recurred, wherefore it cannot be doubted that the diagnosis was exact. Therefore this must be considered as one of the maladies of the teeth which may produce epilepsy.—*Translated from "Odontologia," by Prof. T. H. Chandler*

A CYCLOPÆDIA OF PRACTICAL DENTISTRY.

BY B. R. MCGREGOR, ROCHESTER.

Read before the New York State Dental Society at its eighth annual session, July, 1876, and printed from advance sheets of the transactions of that Society.

"Knowledge is of two kinds. We know a subject ourselves, or we know where we can find information upon it."—*Dr. Sam Johnson.*

A few words concerning the origin and growth of one or two English cyclopædias as typical of the many, and as pointing to, if not illustrating the conditions and circumstances which required, promoted and multiplied cyclopædias in the last century, may not be out of place at the beginning of this article. It is not improbable that the idea of the convenience and utility of condensed summaries of knowledge is as old as the Elizabethan age; but no attempt to produce one such work, worthy of being placed on record, appears to have been made before the beginning of the last century. Since that time the progress of cyclopædias, or alphabetical digests of knowledge, has become a remarkable feature in the literature of modern times.

The first was the cyclopædia of Ephraim Chambers, published at Edinburgh in 1728, in two large folio volumes, of which five editions were published in eighteen years. At the death of Mr. Chambers, in 1740, Dr. Rees took charge of the work, and in 1785 he brought out a new and enlarged edition. The proprietors then agreed with the same gentleman to undertake a new and magnificent work of a similar nature, and in 1802 the first volume of Rees' Cyclopædia was issued, with illustrations in a style of engraving never surpassed in that country. This splendid work extended to forty-five volumes. It certainly was a remarkable ending for an enterprise having, nearly a century before, so modest a beginning. We have reason to presume that the earlier editions of Mr. Chambers' Cyclopædia were probably very small. It was the first work of any pretension yet produced, and the risks of its finding popular favor seem to have been very great. In 1771 the Encyclopædia Britannica was published in four volumes quarto, presenting a novel and important improvement upon its predecessors: "it treated each science completely, in a systematic form, under its proper denomination; the technical terms and subordinate heads being also explained alphabetically, when anything more than a reference to the general treatise was required." In 1776 this work was enlarged to ten volumes. The third edition consisted of eighteen, two supplementary volumes being afterwards added. A fourth edition was completed in 1810. Another in 1824, with an addition of six volumes. This great national work of England, for such it may justly be entitled, was completed in 1842 in twenty-one volumes. The remarkable success of these and other great works of general science and the arts led early to the production of smaller cyclopædias of a popular character. The object sought was to familiarize knowledge by lessening the cost of its acquisition, and making it possible for persons of moderate means to possess the advantages of a library within the compass of a single work. One of these, called the "Preceptor," first published in 1748, long continued to be a favorite and useful book. In two volumes octavo, it contained treatises on elocution, composition, arithmetic, geography, logic, moral philosophy, human life and manners, and a few other branches of knowledge then supposed to form a complete course of education. It probably is as reliable a record as any left of what constituted an education at that period. We must remember that books in the last century were fewer and much more costly than now, although money was worth more and went further.

While we are overwhelmed by a sea of literature on every branch of education, and new books and periodicals are continually pouring in upon us, the cyclopædia becomes a greater necessity from that very excess and cheapness of material. To them the cylcopædia perhaps was equally necessary, if less accommodating, from almost precisely opposite conditions. It is unnecessary to add to what already may have been too much on the general subject of the cyclopædia; but it is worthy of remark, since it is essential to the main purpose of this paper, that the success of the larger works led immediately to the production of cyclopædias of special subjects. That the first essays in this direction were abundantly successful, is proven by the fact that so many of such a variety of subjects were produced from that time forth. It would be tedious and useless to recount them. It is enough to say that perhaps the earliest were of commerce and geography; then followed cyclopædias of arts and manufactures, of rural sports, of architecture, gardening, agriculture, plants, trees, literature, fine arts, music, the physical sciences and a series of larger works devoted to the various departments of medical science, of practical medicine, of anatomy and physiology, of surgery, etc. What has thus been recited on the general subject of cyclopædias is, of course, not new to you, but it seemed desirable to recall to your minds some of the facts in the history of such works for the advantage promised for giving a larger latitude of thought, and a more liberal construction of the conditions which seem to favor the idea of the applicability of the cyclopædia to answer the many special wants of our profession. For the present condition of the profession betrays a lack of unanimity both in practice and theory, and the cause seems to lie in the want of a common standard of authority. The text-books probably are less regarded by the mass than the journals, whose contributions, being sufficiently miscellaneous and discordant on matters of theory and practice, leave every dentist to make his own standard or have none, so that we have every kind of practice with all kinds of theories, and practice without any theory or even method. The profession might be full of really scientific men, but if every one had formed or was pursuing a standard of theory and practice made for himself, the profession, as a body, would appear disorganized and unscientific.

But science has been defined to be *organized* knowledge.

Not long ago our earnest, laborious and worthy President addressed a thrilling appeal to us in behalf of "organization." Every one must have consented to the ability and force of his argument. The same kind of argument might be employed with equal felicity in behalf of a plan which would furnish a common standard of theory and practice, such as is contemplated in a cyclopædia. It would seem that the surest way (though it might be the longest) to promote that organization so greatly needed, would be to furnish a cyclopædia to which the entire literature of the profession, by a process of winnowing the chaff from the kernel, should be compelled to contribute. Some would recognize its merit as an authority, and enjoy it for its convenience; to others it would be attractive, because useful from its practical suggestions and information. "Educational, even when not consulted in a spirit of study and reflection, it would destroy undermining hurtful prejudices, perhaps unconsciously held." In this view of it, as usual, the vexed question of education lies at the foundation.

The journals reflect and record the different phases of practice from year to year of a few; and since much of general practice is regulated by what they suggest, we need a digest of that which is valuable in them, and a full index of their contents. We have had, first and last, about thirty journals, and probably an hundred text-books and treatises; and yet, until 1862, dentistry never found a place, even for the poor honor of mention, in any cyclopædia or dictionary of science and art which the writer has been able to find during a thorough search.

But in 1862 a long treatise on dentistry appeared in the Encyclopædia Americana, and it was republished, without change or addition, in the first edition of Appleton's Cyclopædia; and in the second edition, now in process of publication, it is reduced from its former dimensions.

And yet, as a profession, we have reached that importance, as it were, by a jump, that our condition demands a work of this description for ourselves. Whenever that is produced, it will compel a recognition hitherto denied us, now begrudged or reluctantly given.

Let us for a moment contrast our rise and progress with that of the medical profession. Dentistry is a thing of to-day, while medicine marks its progress by centuries and eras of development. It has a history worth studying. Medicine had first, its *foundation* period, beginning with the Scripture accounts B. C. 1700, and ending with the death of Galen, A. D. 200 ; second, its *transition* period, ending with the discovery of printing in the fifteenth century; and third, its *reform* period, which, with much reason, may be said to still continue.

In the last period we mark the separation of medicine and surgery, and the beginning of distinct specialties. About 200 or 300 years before Christ, physic was divided into three branches, viz.: medicine, surgery and pharmacy, each of which was a separate and independent profession. Celsus informs us there had been a tendency to separate medicine into two or three specialties, and men existed who had peculiar skill in medicine, surgery, and obstetrics. After the separation of surgery from medicine, the creation of specialties seems to have depended upon discoveries which considerably extended the field of special departments. For example, the employment of the forceps by Chamberlain created a complete change in the practice of obstetrics. Another great discovery, which made several new specialties possible, was the use of the mirror to illuminate hitherto dark and unexplored regions.

Though attention had been given to the eye, and oculists had before existed, it was not until after the beginning of the present century that much of importance was known or accomplished in the treatment of that organ. The specialties of the ear and throat are of still later origin, probably because both are more difficult of access.

But the use of the mirror in 1857 enlarged the field of these divisions very greatly, by putting the specialists in immediate relation to the interior of the eye, the ear and the throat, and thus diseases incidental to each were studied, more perfectly understood and successfully treated. And so, to-day, we see in our great centres of population, persons pursuing distinct branches in every department of medicine and surgery, to every organ in the body and almost to every disease. This condition of things has affected the literature of medicine and surgery. Books, considered as standard authorities on different topics, are written by specialists in these several departments. The eye, ear, throat, lungs, heart, abdominal and genito-urinary organs, nervous system, etc., together with the different divisions in surgery, are written up by men who study the literature and give special attention to the clinical consideration of each.

In 1860 Holmes' Surgery was published under a plan hitherto unknown to any extent. Each different topic was given to the man considered especially competent to write it up, and in the preparation of his article he was expected to go over all the literature on the subject and give the best statement which it and his own experience and judgment would help him to do. In several of the papers this idea was admirably carried out. In medicine the same thing is much more exhaustively doing in H. Von Ziemsen's Encyclopædia of Practical Medicine, now in course of publication.

When the subject of the convenience, not to say the importance, of a cyclopædia of practical dentistry was discussed in Buffalo last October, at the joint meeting of the seventh and eighth district dental societies, it is presumed that no one in the convention knew that Dr. Taft, of Cincinnati, was engaged on a history of dentistry in this country, or had heard of the project by the Boston Academy of Dental Science to furnish the centennial history which is now in progress. No doubt the history by Dr. Taft is well advanced towards completion. It must strike almost every reflecting mind, that the concurrence of two such works is very significant of a condition of the profession which favors, if it does not already demand them; (as, indeed, characterizing an hitherto indefinable want which thus finds its expression in the works to which allusion has just been made.) But while the writing a history of dentistry is one and perhaps the most ready and reasonable way of interpreting and supplying that need, it still remains a question, before the works are produced, whether a history is all that is wanted; whether, in fact, however comprehensive and minute, it will fully answer those demands which are most felt. To some, indeed, the want is not greater than the promised supply, but to others, and especially those who are in the habit of contributing to our literature, as well as those who read much, the restricted methods of an historical account of dentistry seem insufficient and somewhat unwieldy, although doubtless including much of that which ought to be known, but not readily and exactly furnishing all the matter about which, in our emergencies, we wish to be precisely and quickly informed. A history is important, and it may be indispensable, but it cannot take the place of a full reference-book to authorities in the ten thousand questions which arise in matters of practice. It will assist, but cannot be full and explicit on all points of inquiry. Yet a cyclopædia would be of less account without a history to refer to; and a history would be of little importance if its statements of facts could not withstand the critical questionings implied in the work of the cyclopædia. A cyclopædia is not only an index to a history, but to all the sources, in practical matter, from which the history was compiled; and it accomplishes much more; it is, in fact, a full exposition of the science and art as well. It is an index to much of that which is necessarily excluded from a history as irrelevant, if not unimportant; and in the instance of the work advocated, should not only be in itself a digest of all information practically useful and therefore valuable, but should contain full references to all authorities on every subject of which it treats. If it excludes all that is doubtful, it will have the higher value of being a condensation of all that is certain, and justify the fact again that knowledge is two-fold, consisting not only in the affirmation of what is true, but the negation of that which is false; and herein it would perform a service by guarding against the reproduction of old ideas as new. While it ought not to be a repository of patents (since it must discourage them), it would record all the inventions and improvements which have been freely given to the profession, and give due credit to the authors; and in every case, whatever has contributed to advance the interests of dentistry in any way, the source from which it was derived would be searched out and made known, at least so far as dental literature could furnish it.

In conclusion, I would remark that the rapid development of resources in dentistry no doubt is to be attributed to the increase of its literature, and the free discussion and dissemination of thought in reference to those things which commonly engage the attention and best efforts of its practitioners. The effect has been to enlarge and perfect the means for overcoming the difficulties with which it contends, and to lessen the labor by which its best achievements are attained. The tendency has been in strict conformity to the spirit of the age in which we live, and that, we well know, is to lessen the sum of human labor as well as to enlarge its boundaries.

THE EFFECT OF ANÆSTHETICS UPON THE HUMAN SYSTEM, AS EVIDENCED BY SPECTROSCOPIC OBSERVATIONS.

BY DR. S. WATERMAN, NEW YORK.

Read at a Meeting of the American Dental Convention, the Southern Dental Association, and the Dental Society of the State of Maryland and District of Columbia, in joint session at Oakland, Maryland, August 16th, 1877.

(After a familiar exposition of the principles and applications of the spectroscope, Dr. Waterman continued as follows:)

I think I have touched, like Ithuriel's spear, lightly upon the most salient technical points necessary, so that you may understand in how varied a manner the spectroscope may be utilized.

We come now to its application in medicine, and I claim that its usefulness and importance here is second to none I have already mentioned.

But to understand how it can show us the effect of anæsthetics upon the human system, we must be familiar with the constitution of the blood, and learn the optic relations of this vital fluid to the spectroscope, in health and disease.

The optic phenomena of blood were not known prior to 1864, when, almost simultaneously, Hoppe Seyler, in Tubingen, Germany, and Dr. G. G. Stokes, in England, investigated this subject. Stokes pointed out the fact that blood causes a peculiarly strong absorption of light in the yellow and green part of the spectrum. In order to observe this absorption well, the blood should be properly diluted, for, in its concentrated state, the absorption bands between D and E cannot be observed at all.

These two bands are beautifully dark or black, the first, which is narrow, more so than the second, which is broader; both are known as the spectral bands of oxidized blood. But blood can exist in a double state of oxidation; that is, it may also exist in a state of complete deoxidation. The oxidized blood corresponds to the arterial; the deoxidized to the venous blood. When the blood is deoxidized the two bands disappear, and are replaced by one dark, broad band, known as Stokes' reduction band. This black band, filling the space between D and E, appears whenever the blood is deprived of its oxygen, which it loosely binds.

This deoxidation may be effected by mechanical as well as chemical means. The blood is then called reduced or deoxidized blood.

We may deprive blood of its oxygen mechanically, by means of an air-pump, favored by heat. Chemically, blood may be deprived of its oxygen by substances which have an energetic affinity for oxygen, and absorb it whenever they find it—tin-oxydul, ammonium sulphide and others. Blood thus reduced, or deoxidized, may be rapidly reoxidized by shaking up the solution with atmospheric air.

The spectroscope is not idle during these changes; the reduction invariably causes the appearance of Stokes' reduction band; the reoxidation causes the reappearance of the two beautiful bands between D and E. The same changes take place in the living economy.

In the meantime the discovery was made that blood contained a crystallizable material called hæmato-crystalline, also hæmo-globulin and cruorine. The great practical importance of this substance must be my apology for entering more minutely into its consideration.

Hæmato-crystalline is the agent through which oxygen is abstracted from the air, and loosely bound in the circulation. Take this crystallizable matter out of the blood, and the residue, consisting of albumen, globuline, protagon, cholesterine, sulphur, iron, and some salts, will be quite unable to effect this attraction of oxygen. Hæmato-crystalline saturates itself in the lungs with oxygen, it carries its precious burden into the sanguineous circulation, and sustains there the energies of respiration, oxidation and oxygenation. In its course it gives up its oxygen thus absorbed, to all oxidizable tissues with which it comes in contact, and in exchange unites with carbonic acid, which, through the venous circulation, is brought back to the lungs for elimination, by a process not yet fully understood.—(*Hoppe Seyler.*)

It must be evident to you that so long as the hæmato-crystalline of the blood remains intact, the same in quantity as in quality, the supply of oxygen to the living economy is subject to relatively unimportant oscillations, and that with the increase or decrease of this substance, or with any change in its integrity, rises or falls the vital capacity of an individual's life.

That it is beyond any question the hæmato-crystalline, and not any other substance of the blood, which enters into and sustains the vital exchanges between the oxygen and carbonic acid, is fully proved by spectral observation. Hæmato-crystalline, artificially prepared and in solution, is able to absorb oxygen as well as carbonic acid with great rapidity. It presents two states of oxidation, the arterial and venous. It can be oxidized and deoxidized at pleasure; it presents the same absorption bands as blood; it can be reduced, and when shaken up with air can be readily reoxidized. It presents the same optical changes when reduced or altered. It enters the same combinations with irrespirable gases. In short, all and every chemical and optical appearance which blood presents when acted upon by chemical as well as mechanical agencies, are also observed when these agents act upon a solution of hæmato-crystalline.

Highly interesting experiments, instituted by Pfluger upon dogs, have given us information of the rapidity with which oxygen is used up in the living animal economy. This physicist forced these animals to inhale nitrogen, which, you know, does not support respiration. In thirty seconds the highest point of dyspnea was reached.

At this point some blood was abstracted, under the necessary precautions, and then tested for oxygen. It was found that its oxygen was reduced to a minimum, being one to two per cent., whilst the blood abstracted from the same animal immediately before it was forced to inhale the nitrogen contained 18.6 per cent. of the vital gas.

As soon as the animals were permitted again to inhale the pure air, the dyspnea disappeared and they seemed as well as ever.

You perceive, gentlemen, I have guided you gradually up the hill from which your views will become clearer and fuller. If you will but grasp these facts presented to you, you will have no difficulty in mastering what follows.

Were it possible to observe in the spectroscope the changes taking place in the blood of such a suffocating dog, we would witness a rapid fading away of the two oxygen bands between D and E, and towards the end of the catastrophe one dark band would take their place, the reduced or deoxidized band of Stokes; and by the time this band had obtained its full extension and its full depth of shading, poor dog Tray would have gone to his eternal hunting.ground.

And here comes in the first great lesson in the administration of anæsthetics: That suffocation will rapidly ensue where anæsthetics are used which cannot sustain respiration, or, which is still worse, abstract what supply of oxygen the blood has stored up, unless a sufficient supply of atmospheric air is permitted to be inhaled to sustain life at the same time.

The great rapidity with which the dogs experimented upon recovered, shows us that the blood itself had not been fatally injured or altered. In taking the blood drawn at the height of the dyspnea, and shaking it up with air, the spectroscope would have promptly informed us of the reappearance of the two oxygen blood-bands, in full depth of shading.

To Pfluger's experiments we owe another series of important facts. The amount of oxygen contained in the animal and human blood is 16.9 per cent. Blood serum contains less than one per cent. The more compact and normal the blood, the more numerous the blood corpuscles are, the greater is the percentage of hæmato-crystalline, the greater is also its capacity to absorb oxygen; the poorer the blood, the smaller is its amount. One grain of hæmato-crystalline is able to bind 1.27 cubic centimetres of oxygen.

When we examine spectroscopically the blood of chlorotic persons, or that of persons who have sustained severe hemorrhages, or who suffer from pernicious anæmia, Bright's disease, fatty degeneration of the heart, or the blood of persons in whom disease has reduced the crystallizable coloring pigment of the blood, as is the case after cholera, typhoid and other diseases, we find the bands paler, and know at once that the normal amount of oxygen is wanting in such individuals.

Here, then, comes in our second great lesson. In all cases, due inquiry should be made into the history of the person who is to be placed under the influence of anæsthetics, and if it is found that any of the diseases enumerated above have been present, and that the hæmato-crystalline has been reduced by disintegration and retrogressive processes, leaving your patient with pallid countenance and defective heart's action, be on your guard, for what remains of the vitalized blood may not be able to resist the effect which your anæsthetic is apt to produce, because in these conditions every anæsthetic agent is dangerous.

Let me briefly make you acquainted with agents which permanently alter the blood. All acids as well as nearly all alkalies are such agents. With these changes we witness corresponding changes in the spectrum, quite definite and characteristic. Here you see on the diagram various spectra resulting; hæmatin and cruentine, hæmatidin and hæmin. I have no time to dwell upon their great importance in spectral analytical investigation, but will refer to them by and by.

The blood crystals of which we have so often spoken are not found in crystalline form in the blood. They are present there in solution joined to an alkali, probably to potassa carbonate, forming hæmo-globulate of potassa. (Preyer), hæmato-crystalline is a weak acid. It can be produced pure, but its preparation is difficult. It crystallizes in rhomboid prisms of great beauty and bright red color.

AFFINITY FOR IRRESPIRABLE GASES.

Wonderful as are the functions of this crystalline material, it possesses qualities whereby destruction to life is invited and facilitated. They have an exceedingly energetic affinity for irrespirable and poisonous gases, with some of which they enter into close and inseparable combinations, thereby sacrificing their own integrity and life-supporting power forever. Some of these irrespirable gases simply disable the hæmato-crystalline of the blood to absorb oxygen; others consume all the oxygen of the blood to satisfy their own keen affinity for this gas; others cause a cleavage, or true chemolysis of the hæmato-crystalline, combining with its alkaline base, setting free the crystallizable material, while still others cause several of these effects to take place at one and the same time.

When a cleavage of the blood material has taken place, the disintegrated elements become foreign bodies, and must be eliminated and carried from the system.

Preyer's experiments upon dogs remind you how rapidly the oxygen is consumed in the animal economy, and how necessary it is to supply the defect in an equally speedy way, and you can understand how rapidly a fatal result must ensue from the action of anæsthetics which cannot supply the defect, and which, in addition, greedily appropriate the oxygen which the blood may have stored up, and still further destroy the integrity of the hæmato-crystalline, in a manner so as to paralyze its vital functions. Some of these combinations can be obtained in a crystalline form. We can thus produce the prussic acid, the carbonic oxide and the nitric oxide hæmato-crystalline. The combinations are far more stable than the normal oxyhæmato crystals are.

When blood has once entered into a permanent crystalline union with nitrous oxide gas, we know as yet of no chemical process to restore the resulting nitrous-oxide hæmato-crystalline to its normal condition No electric current possesses the power to restore the primitive integrity of the blood when once brought into this fixed condition.

Recently Donders and Zuntz have demonstrated, and Podalinsky and Eulenberg have corroborated, that the hæmato-crystalline may be released from the deadly grasp of carbonic oxide by means of carbonic acid, hydrogen and oxygen, being persistently passed through a solution of carbonic oxide hæmato-cryst, so that the blood-band of Stokes and finally the two bands of oxyhæmato-crystalline may be reproduced. Whether such a process would succeed, in case of blood saturated with nitrous oxide, whose grasp upon the oxygen of the blood is far more tenacious, is a question which cannot be answered at present.

NITROUS OXIDE GAS.

Let us begin with this gas, the so-called laughing gas, the one so extensively used by surgeons and dentists, and by many considered a serviceable and harmless agent.

It has been demonstrated by Herrman and verified by Hoppe Seyler, Gorup Besanez and W. Preyer, that nitrous oxide gas possesses a very keen affinity for oxidized blood as well as for artificial oxyhæmato-crystalline in solution. The affinity is so strong, that when a current of this gas is passed through a solution saturated with carbonic oxide hæmato-crystalline, the carbonic oxide is driven out by the nitrous oxide, which takes its place volume for volume.

When a current of nitrous oxide gas is forced through a slightly alkaline solution of hæmato-crystalline, the solution loses its dichroism and assumes a slight carmoisin red color. When the solution is placed before the spectroscope we observe that in proportion as the gas exerts its influence, the two bands between D and E fade away and disappear finally altogether, and there is a moment, says Preyer, "when the spectrum is continuous."

The disappearance of these blood bands means here, as it means in other instances, disappearance of oxygen from the blood, or complete deoxidation, and unless a fresh supply is speedily furnished, suffocation must ensue.

As the action of nitrous oxide gas upon the blood solution continues, soon after the fading away of the two bands, two new bands appear, resembling the oxy-blood bands, but differing from them in position and depth of shading; they are paler and more blurred in outlines.

Please remember, in this connection, what I said to you about Stokes' reduction band. I then told you that when blood is simply deprived of its oxygen, the blood reduction band would follow the disappearance of the two oxidized broad bands; and that then the simple contact of atmospheric air with such deoxidized blood solution would suffice to cause the reappearance of the two oxygen blood bands.

But we see here, that instead of Stokes' band, two entirely new bands have made their appearance; and when such blood, saturated with the nitrous oxide, is then submitted to the action of reducing agents, the broad band of Stokes, the reduction band, can no longer be produced at all, proving that a more permanent change has taken place in the vital chemistry of the blood.

When a current of nitrous oxide gas is passed through a blood solution not made previously alkaline, still further changes take place. Here a portion of the nitrous oxide gas rapidly oxidizes, at the expense of the oxygen of the blood, and forms hyponitric acid Preyer holds that this hyponitric acid (Unter Salpeter Sauere) unites with the hæmato-crystalline of the blood in its nascent state. Like all acids, it alters and suspends the coagulability of the blood, and initiates other important chemical and optical changes.

This event is marked by the appearance of an absorption in red to the left of D, from the 53° on Preyer's scale towards D, and another one between b and F. I look upon the appearance of this absorption in red as an indication that hyponitric acid has formed and has united with the blood. We have already learned that all acids, cyanic acid excepted, cause a decomposition of the blood, and its product is hæmatine.

Now let us logically apply all these ascertained facts to our case in hand, in order to learn how this gas produces its effects upon the economy.

It deprives the blood of its oxygen, and enters into a close combination with its crystallizable material; so bound, it disables this latter to absorb oxygen from the air, or to supply it to the oxidizable tissues of the economy.

In Preyer's experiments we have seen that the dogs, when permitted to inhale oxygen at the highest stage of the dyspnea, became rapidly as well as ever. Not so after the inhalation of nitrous oxide gas.

A certain effect upon the blood has taken place; often unimportant and transient; at other times more permanent and grave; sufficient, at times, to endanger life itself.

We have also seen that, under favorable conditions, hyponitric acid is formed, which causes a decomposition of the hæmato-crystalline into hæmatine, a substance which is not capable of sustaining life.

Thus we are forced to acknowledge that the application of this gas is far from being safe and harmless; that, on the contrary, it is pregnant with grave consequences.

"These facts," says a writer in Braithwaite's Retrospect, No. 67, July, 1873, "ruthlessly destroy the infatuation that the inhalation of nitrous oxide gas is a harmless process—a process which any man, educated or not educated, may carry on without danger of destroying life. The recent death which occurred at Exeter, on the afternoon of January 22d, of this year, furnishes a lesson not to be forgotten. The gas was administered by Dr. F. F. Mason, for the purpose of the painless extraction of a large upper molar tooth. The lady, Miss Wyndham, was about 38 years of age, in good health. Her physician, Dr. Pattison, was present. Gas from the same source had been administered to other patients, so that its quality could not be impugned. She took the gas in the usual way, without any symptoms to excite uneasiness. At the proper degree of insensibility the gas was stopped and the tooth extracted. It was not until after the operation was completed that anything unusual happened; her face suddenly became livid, and the features began to swell, and she seemed to be quite unconscious. She breathed two or three times, and in a few moments her pulse ceased to beat. All attempts to restore her were fruitless.

There was no obstruction to the air-passages, and the tongue was protruded while she still respired."

The writer continues: "From no agent have there been so many hair-breadth escapes from death as from this gas, and probably of late some persons every day have been brought within the minutest line of danger to which Miss Wyndham succumbed."

We learn the most important lesson, that we have a great deal to learn before we shall have perfected anæsthetic agents: toward such learning the re-introduction of nitrous oxide gas has been a serious check.

"Nitrous oxide gas is, indeed, not a true anæsthetic at all. A true anæsthetic is an agent that suspends common sensibility without, by any necessity, interfering with those organic processes on the continuance of which life depends. Nitrous oxide gas acts by suspending one of the most important of the organic processes—that of respiration. The insensibility produced by this gas is afforded during an interval of partial death. This interval, doubtful, transient, dangerous, may allow an operator time for a short operation, and suspending the inhalation, the function may return; but that it may never return, the above case furnishes a lamentable proof."

This was written in 1873, and many other cases of death from this gas are since recorded. Two years previous to this, in 1871, my warnings had reached England, and had, in part, been published there in the *Medical Times and Gazette*, London, January 13th, 1872. It was a lecture delivered before the New York Academy of Medicine, in 1871. Touching nitrous oxide gas, I made the following remarks: "No intelligent observer, who ever witnessed the ghastly, cyanosed appearance of persons who have inhaled this gas until its anæsthetic effects are produced, will deny that the ensemble of symptoms betokens a powerful influence upon the blood mass, which continues for many hours and days. I have seen some cases where the inhalation of this gas was followed by pulmonary and cardiac disease and death. The profession at large may yet learn to modify its opinion regarding its freedom from danger after its application."

You may remind me that in a dental institution in New York we are shown a gigantic roll, containing the names of many thousands who have inhaled this gas there, so far, without any direct fatal effect.

But how is it with after effects? The institution referred to keeps no record of what becomes of its patients afterward.

One of my fatal cases—dying from after effects—had inhaled the gas there three or four months previous. She was a perfectly healthy woman before the inhalation, and her disease began right after it. Other well-authenticated cases are not wanting to prove that nervous disorders of many kinds, and a train of organic diseases, follows its exhibition. Dr. Frank Hamilton, of New York, attended a case of incurable epilepsy, directly produced by the inhalation of this gas. Dr. F. R. Thomas, in his treatise on "Nitrous Oxide Gas," says: "It resembles strongly in its effect an attack of congestive apoplexy. Many are deprived of sleep long afterwards, and complain of unremitting headaches; nor are instances rare, where, after its use, vertigo, syncope, melancholy, insomnia, convulsions, hysteria, and irregular heart's action, could be attributed directly to its use." *(Dr. Geo. J. Ziegler's Researches on Nitrous Oxide.)*

Having fully pointed out to you the manner in which nitrous oxide gas affects the blood, it must serve you as a type for all those agents which deprive the blood of its oxygen, and form stable crystalline compounds with its hæmato-crystalline, whereby its life function is gravely impaired, and under certain conditions forever lost.

In case of accident with nitrous oxide, our indications are confined to narrow limits. We must try to economize the still intact blood corpuscles, and by transfusion, and especially by artificial respiration, to favor a full and long supply of oxygen to sustain the little flame of life. Electricity may be used to keep up the muscular action of the heart and lungs. We may thus succeed to ozonize the accumulated nitrous oxide, and to eliminate it from the system. Porowsky has thus succeeded in some almost hopeless cases of poisoning with carbonic oxide, and the procedure seems to me well adapted, also, in cases of poisoning with nitrous oxide gas.

The next class affects the blood by causing a mechanical breaking up of the blood corpuscles, or a true chemolysis of the blood elements. This class, says Hoppe Seyler, does not affect the function of the hæmato-crystalline, but prevents oxygenation and oxidation in the tissues.

CHLOROFORM.

The introduction of chloroform into the blood current is noted for its energy and corresponding danger. Experiments made with this agent upon the blood, show that the hæmato-crystalline is precipitated from its solution, a gelatinous mass is formed, leaving a ghost of a stroma in the shape of empty cell-walls.

Preyer says that "the spectrum of the precipitated hæmato-crystalline is normal, and the two bands between D and E are clearly seen." The force of chloroform is therefore not spent upon the hæmato-crystalline, and the mischief done must be sought in the results of a cleavage in which the hæmato-crystalline is forcibly expelled from and exudes from the blood corpuscle. It is probable also that it is thus forcibly separated from the potassa carbonate. In a fatal case of chloroform inhalation, reported in the *New York Medical Record*, Sept. 1st, 1877, post-mortem examination revealed that the immediate cause of death was effusion of blood upon the brain. It will be seen that the foregoing view tallies with this pathological condition. Chloroform forms no combination with the blood in the manner nitrous oxide and other chemical agents of like nature do.

Chloroform possesses another characteristic that adds to its fatal influence when inhaled; it is, its high boiling point, requiring a great amount of vital force, a great amount of oxygen to ozonize and to eliminate it from the economy. It is a well ascertained fact that in all anæsthetic agents the boiling point is of the highest consequence. The higher the boiling point the greater the probability of danger. Professor Silliman says, "The main disadvantage of chloroform is its high boiling point, requiring a great amount of vital force to eliminate it from the body, so that it is probably never eliminated entirely by the lungs, but only with the aid of all excreting organs, any deficiency or derangement of which may consequently lead to such suppression of elimination, that the nervous system may be overwhelmed with consequent arrest of their activity." *(Silliman's Lecture, 1871.)*

It is but fair to state that here, also, is a great deal to learn of the mode in which chloroform spends its force in the living economy. The warning given when I spoke of nitrous oxide gas, regarding the danger to give this agent to debilitated persons, or to those laboring under organic disease, and in impoverished conditions of the blood, must find a still more grave consideration here. How the extravasated hæmato-crystalline is carried out of the system is a matter of surmise. I found very frequently sugar in the urine after the inhalation of chloroform.

Prof. Silliman thinks the best treatment in impending death, from chloroform, is the introduction of air into the lungs by artificial respiration—heated to 130° F.—by means of bellows.

ETHER.

The action of ether is somewhat different. You remember that, in speaking of the blood corpuscles, I mentioned protagon and cholesterin among its constituents. Protagon is a saponified phosphor-oleate, according to Dia-Rouon and Strecker, an emulsion of cerebric acid and lecithin.

Albumen, protagon and cholesterin form the medullary part of the nerves; and their great importance to the animal economy is conceded by all. They are found stored up in animals as well as plants, and support all vital processes of germination and growth.

Formerly indeed their presence was not considered of very great importance. It was thought these substances had only a subordinate function to perform. We know now that they furnish elements for the brain, and are ever present in the primitive vital elements of the seminal fluids, the yolk of eggs and in the red as well as white blood cells. Ether dissolves these important factors out of the blood, as well as out of vegetable seeds—such as peas, beans and lentils; it breaks up the determined constitution of the blood cells, and thus affects directly the hæmato-crystalline by severing its association with potassa carbonate.

When ether is shaken up with fresh blood a gelatinous mass is formed; the bright cherry red is changed into a muddy, brown-colored pigment. When this change is observed by means of a gas chamber, such as used by Stricker and Lancaster, and the spectroscope, we find that in addition to the oxyhæmato-crystalline band between D and E, there also appears a third band near C in the red part of the spectrum. (See Preyer, die Blut-crystalle, p. 146.) The band in red always denotes that grave changes have befallen the blood, and Hoppe Seyler thinks it is due to the formation of methæmoglobin.

Fortunately for suffering humanity the boiling point of ether is far below that of chloroform, and less oxygen is needed for its elimination from the system. Yet ether has also its death-roll like chloroform and other agents, less appalling it is true, but still all caution is necessary, and eternal watchfulness and care.

And now the end has come, undoubtedly to your great comfort and relief. I thank you for your undivided attention during the delivery of my remarks. I hope they may stimulate thought and original investigation, and give encouragement to unceasing efforts, until the great boon to humanity, "a perfect anæsthetic," is found.—*American Journal of Dental Science.*

Surgical and Medical Selections.

THE GERM THEORY.

NOTES OF A LECTURE BY PROFESSOR TYNDALL, F.R.S.,

At the Royal Institution, London.

It is a well-known fact, that infusions of vegetable or animal substances, which when made are transparent, become in the course of a few hours, if kept at a proper temperature, turbid, and their sweet smell becomes putrid. This is owing to swarms of minute organisms, which, from their appearing in infusions, are called Infusoria. The lowest class of these are called Bacteria.

There are two theories as to their origin. One that they are developed from eggs or germs, like the higher forms of animal and vegetable life; the other, that they arise spontaneously.

The chief advocate of the latter theory is M. Pouchet, of Rouen. His writings show how he arrived at his conclusions. He convinced himself by "meditation" that spontaneous generation was one of Nature's modes of action, and then set to work to find evidence in support of his theory. His works are partly scientific, partly teleological, and partly satirical. He twits the "ovarists" with the difficulties of their theories. If there is a vast number of germs floating about in the air, as alleged by them, why cannot we see them? From their accounts they should form a thick, dark cloud obscuring the sky. These theories were inconsistent with the idea of a creative wisdom.

However, Professor Tyndall said it was an established fact that the blue of the sky, as seen from the highest elevations, and above possibility of contamination with earth, was caused by vast numbers of foreign bodies floating in the atmosphere, so small as to be undistinguishable by a microscope magnifying by 1,500 diameters. This had been the highest power available, until Dallinger (to whom Professor Tyndall referred in terms of eulogy as a microscopist worthy of a far wider reputation than he had attained) had produced a power magnifying 15,000 diameters. This, however, failed to distinguish these minute germs. The only means of discovering their presence in the atmosphere was the electric light.

During his investigations or "battle with the germs," which occupied him for six months in 1875-76, he had found it to be a rule without exception that an infusion of turnip, cucumber, beef or mutton, which had been boiled for a period of five minutes, would not putrefy in an atmosphere in which all germs had been allowed to subside. But during the continuance of these investigations in the autumn of 1876, he found that infusions apparently the same as those prepared in the previous year were not sterilized by boiling for fifteen minutes. There was no opposition, to his mind, between these results; the only question was, whence did the difference arise? Either these infusions had, in October, 1876, a power of spontaneous generation which they had not in 1875, or there was a more obstinate contagium present in these which the former had escaped.

Acting on the assumption that the latter was the correct interpretation, he transferred his experiments from the Laboratory at the Royal Institution to the Jodrell Laboratory at Kew, in hopes of obtaining a purer atmosphere. The result was, that five minutes' boiling at Kew was sufficient to sterilize infusions which had withstood boiling for 200 minutes at the Royal Institution. Either the infusions had lost a generative power at Kew which they possessed in the Laboratory, or there was a special contagium in the air of the latter place. Next, he erected on the roof of the Royal Institution a shed in which he put his chambers. The infusions were carefully prepared in the shed, but the result was failure—the atmosphere in the shed was as bad as that in the Laboratory. It occurred to him that the shed might have been infected by his assistants passing to and fro between it and the Laboratory, and bringing the contagium with them. He therefore disinfected the shed by washing it with carbolic acid and water and caustic potash. He and his assistants wore proper uninfected clothes, and the result was that the infusions again became sterile after five minutes' boiling. A rod thirty feet long would connect the shed with the Laboratory. Had the infusions a generative power at one end of the rod, which they had not at the other end? or was the difference caused by a special contagium present in the Laboratory and not in the shed?

After exhibiting some specimens of infusions to illustrate the results of his experiments, the Professor pointed out the parallel between the spread of infection from the Laboratory to the shed, and the spread of infectious diseases in hospitals and other places by means of the passage to and fro of attendants.

The Professor then exhibited, by means of the electric light, the contagium in a sample of old hay brought from Heathfield, in Sussex, clouds of fine particles being seen to arise from the hay when shaken beneath the ray of light. This contagium was far more infectious than that ordinarily found in common air, and far more obstinate. The particles were extremely fine, and able to pass unaltered through 300 layers of filter-paper. This was the contagium which had infected the Laboratory, and was so remarkable for its resistance to heat.

If these were its effects on infusions of turnip or beef, what might its effects not be on open wounds in a hospital? This was a matter now being taken up by the followers of the Antiseptic School of Surgery, and was well worthy of the attention of all surgeons.

This difference between the powers of resistance of various species of contagia was of great moment with regard to the artificial preservation of meats and vegetables. He was not aware of any actual instance, but could imagine great financial reverses occurring to those engaged in these trades by infection from a contagium which would withstand the ordinary means of preservation from putrefaction. He knew that brewers were sometimes liable to checks from causes apparently inexplicable, and he thought that much might be traced to the special form of contagium. It would be possible to cause a great disaster by carrying a truss of hay like that which he had just exhibited through a preserving establishment or a brewery.

The Professor then referred to some tables exhibited on the boards above, giving a summary of the different periods for which he had subjected infusions of old hay, of turnip, and cucumber infected with hay dust, and of beef prepared in an infective atmosphere. The result appeared to be that the turnip and cucumber infusions could stand boiling for 180 minutes and yet putrefy. The beef putrefied after boiling for 300 minutes, and the old hay after boiling for 240 minutes. In one instance a sample of the hay infusion showed life after it had been boiled for 480 minutes—eight hours.

Boiling does not destroy the power of putrefaction possessed by any substance; it destroys, or is intended to destroy, the germs that are in the infusion or substance at the time. The germs that make an infusion putrefy are those in it, and not those in the air above. This the Professor had established by using a special form of bulb, which he was enabled to fill with purified germless air before he introduced the infusion. The infusion nevertheless putrefied, showing that it was the germs in it, and not any outside it, which were the cause of its putrefaction. When an infusion has been sterilized it may again be made putrefactive by introduction of fresh germs.

It was a grave error to confuse the germs of infusion with the adult forms. Heat destroyed the adult organisms, but the germs from which they sprang were comparatively indestructible. This was illustrated by the results of Professor Koch's researches on that dangerous and fatal disease, *Milzbrand.* He had found that an animal might with impunity take the adult organisms after they had been subjected to a very small amount of heat, but that the germs would withstand a lengthened period of boiling without losing their power of development. One minute's boiling will kill the adult, while eight hours is insufficient to kill the germ. It was not even necessary to raise the heat to boiling-point, for a heat of 145° Fahr. would kill the adult.

One result of his (Professor Tyndall's) experiments had been the method of disinfection by discontinuous heating. The substance to be disinfected should be subjected for one minute to a temperature of 140° degrees Fahr.; this would kill all adult organisms. After a few hours' intermission, during which the substance is kept at a proper temperature, to enable the indestructible germs to arrive at a sufficiently sensitive stage of existence, the substance should be again subjected to a mild heat. By this method an infusion would be more perfectly sterilized by an amount of heating which would in the whole amount to five minutes only, than by boiling for many continuous hours.

In one instance Professor Tyndall had noticed that an infusion contained in a sealed flask partially putrefied; a thick scum formed on the top, and the lower parts remained clear. From this and other reasons it had been inferred that bacteria resembled higher organisms in their dependence on oxygen for existence, and that in the present case the bacteria had crowded to the top of the liquid infusion to follow the air, and had thus stifled those beneath. He also showed an instance of a small quantity of a putrefying infusion which had quite exhausted all the oxygen in the large sealed flask in which it had been kept for some time.

Infusions from which air had been perfectly exhausted by means of the Sprengel air-pump had also remained sterile.

On the assumption that the mode of life of these lowest forms was the same as those of the highest, and knowing that it had been proved by experiment on the higher animals that an excess of oxygen acted as poison (an experiment which the Professor had never performed, and was not likely ever to perform, but of which he took occasion to say that he did not see how science was to make progress, and how diseases were to be combated without such experiments), he tried the experiment of subjecting infusions of highly putrefactive matter, such as cucumber and turnip, to pressure of 200 atmospheres of oxygen, and found that they remained quite sterile. This result was not due to the mechanical pressure, but to the poisonous effects of the oxygen, for infusions subjected to a like pressure with common air had putrefied.

In conclusion, the Professor said that he hardly thought it necessary to summarize what had been there brought before his audience. In fact, the whole discourse was but a summing up of eight months of incessant labor. From the beginning to the end of the inquiry there was not, as had been seen, a shadow of evidence in favor of the doctrine of spontaneous generation: there was, on the contrary, overwhelming evidence against it; but he warned his hearers not to carry away with them the notion sometimes erroneously ascribed to him, that he deemed spontaneous generation impossible, or that he wished to limit the power of matter in relation to life. His views on that subject ought to be well known. But possibility was one thing, and proof was another; and when in the present day he sought for experimental evidence of the transformation of the non-living into the living, he was led inevitably to the conclusion that no such evidence existed, and that in the lowest, as well as in the highest of organized creatures, the method of nature was that life should be the issue of antecedent life.—*Medical Times and Gazette.*

ON CONTAGION.

The two problems at present absorbing the attention of scientists (medical and lay), are the Evolution of Life and the Germ-nature of Contagium. In the following pages we desire to side neither with the panspermists nor with the heterogenists. We shall trace the origin of contagium no further than published researches enable us, shall avoid all hypotheses respecting its relations to the evolution of life, and shall keep ourselves uninfluenced by any theory of fermentation and putrefaction. There exist a sufficient number and variety of observations to allow us to state certain potent reasons for applying the term *germ* to the ultimate entity of contagium, in so far, at least, as found in some contagious diseases. With the primary origin of such an entity or entities we do not concern ourselves, as this is as yet an unfathomed ocean; on the other hand, recent observations throw light, to a certain extent, on the behavior of contagium under certain conditions; but of the further development of any one contagium, or its transmutation in form or substance, we know nothing positive. So, also, the relation of contagia to one another is as yet a strange inquiry.

What reasons are there for believing that "many diseases are due to the presence and propagation in the system of minute organisms, having no part or share in its normal economy?" On what observations is the Germ Theory of disease based? What proof have we of the "*competence of germs to produce the phenomena of disease?*" In the next place, are all germs capable of producing diseases of similar natures—are they of like form, of uniform habits, or in what respects do they differ? Most investigations into the nature of contagium have been made with vaccine virus. To discover this contagium the microscope was first used, and Dr. Lionel Beale, in December, 1863, announced the discovery of transparent particles of extreme minuteness in vaccine lymph, and expressed his conviction that the contagious or active properties of the lymph lay in these particles. This observation is now admitted beyond doubt, but the relation of these particles to infection, and their physical properties, were debatable points, till a few years later M. Chauveau submitted vaccine lymph to physical tests. Having proven, through separation by subsidence and through filtration, that the leucocytes and other constituents of vaccine lymph did not retain its infective power, but on the contrary, that its serum (which by microscopic examination revealed those minute sparkling particles) were still virulent, M. Chauveau proceeded to separate these "elementary granules" of the serum, now often termed micrococci, by means of diffusion. From such experiments he concluded "that the vaccinal serosity is not virulent, and that the activity of vaccine resides in the solid granules, either in all or only in one part of these little elementary organisms." M. Chauveau's researches, contained in the two papers in the "Comptes Rendus des Séances de l'Académiè des Sciences" for 1868, led Dr. Burdon Sanderson to test these observations, improving the method of procedure in various particulars. Still later, Dr. Braidwood and Mr. Vacher employed diffusion for the purpose of separating the contagium of vaccine, and by attention to certain details overlooked by their predecessors, they may be said to have avoided all possible sources of error. All these observers have arrived at the same conclusion, viz., that "we possess the strongest proof (we can have no direct proof till we have learned how to wash off all traces of plasma from the bodies it suspends) that the contagium of the virus with which we are most familiar consists of transparent particles, not exceeding (according to Sanderson, the 20,000th of an inch in diameter, neither soluble in water nor in watery liquid, and not capable, without losing its properties, of assuming the form of vapor. Further, inasmuch as these particles do tend to subside, though (according to Chauveau) they never dispose themselves completely in the lower layers, we are assured that they are of a specific gravity only slightly greater than that of the plasma surrounding them, while, from their not sensibly diminishing the transparency of the liquid containing them, they refract light in the same degree as this, and by examining fresh vaccine microscopically, any one can observe these minute, highly refractive, colorless bodies, to be moving, and to form groups of threes and fours. Now, these minute, distinctive particles (Sanderson's micrococci) are to be seen, not only in vaccine lymph, but also in the lymph of human and ovine variola. Hence it may be concluded that such are the physical characters of the contagium of the virus of all the diseases composing the variolous groups.

It may be concluded beyond dispute that certain infectious diseases are induced in the system by a "morbific agent, which is propagated in and given off from the bodies of the sick, and is capable, when received into a susceptible healthy body, of producing in that body a disease similar to the one during whose course it was formed." (Maclagan, p. 5.) Further, the particular nature of the contagium, or morbific agent of infectious diseases, is not only sufficiently defined by the observations above described, but it offers a ready explanation of a well-known, and, on any other view, an inexplicable fact in the history of infectious diseases—viz., that of two persons situated in exactly the same circumstances, and exposed in exactly the same degree to a given infectious disease, the one may be seized after a single exposure, while the other may be equally exposed for months without being attacked, and may even escape altogether. The contagium particles in a patient's breath resemble an enemy's bullets. The breath would be harmless without the particles, just as an enemy's powder would be without his bullets.

But what evidence is there in favor of regarding the contagium particles as organic germs or products of animal or vegetable development? As Dr. Baxter states with emphasis in his "Report on an Experimental Study of Certain Disinfectants" ("Reports of the Medical Officer of the Privy Council," new series, No. vi.), the "characteristic quality of a contagium or virus of a communicable disease is its capability of undergoing almost unlimited multiplication when introduced into an appropriate medium;" hence, also, its effects are to a great extent independent of the quantity introduced into the system. "This power of development, and this faculty of breeding true, were the first, and have ever been regarded as the chief arguments in favor of the germ theory of disease," observes Dr. Maclagan, "and it is difficult to see how these properties of contagium can be accounted for on any other view of its nature." It would be superfluous here to follow Dr. Maclagan's description of the chemical analogy of contagium to the process of crystallization advocated by some. Another argument in favor of the germ nature of contagium is that, like all organized matter, it is prone to undergo change when separated from the conditions essential to its vitality; and this very proneness becomes an argument, not against, but in favor of the view which regards it as consisting of minute organisms. "If all the ova of every parasite came to maturity few animals would be free from these pests. If every small-pox germ which came into existence developed and reproduced its kind in the same way as the parent from which it sprung, the civilized world would have been all but depopulated before the days of

Jenner." While chemistry and physic, moreover, throw no light on the mode of growth or reproduction of contagium particles, the microscope has assisted, though it has not unraveled this mystery. Dr. Beale, for example, has figured the reproduction of these particles from the contagium particles found in the secretion in various diseases. He summarises the results of his observations thus in his brochure "On Disease Germs," p. 244: "Without, therefore, pretending to identify the actual particles of the living bioplasm of every contagious disease, or to be able to distinguish it positively from other forms of bioplasm, healthy and morbid, present in the fluids, on the different free surfaces, and in the tissues in such vast numbers, I think the facts and arguments I have advanced prove—first, that the contagious virus is living and growing matter; secondly, that the particles are not directly descended from any form of germinal matter or bioplasm of the organism of the infected animal, but that they have resulted from the multiplication of particles introduced from without; thirdly, that it is capable of growing and multiplying in the blood; fourthly, that the particles are so minute that they readily pass through the walls of the capillaries, and multiply freely in the interstices between the tissue elements or epithelial cells; and, lastly, that these particles are capable of living under many different conditions—that they live and grow at the expense of various tissue-elements, and retain their vitality, although the germinal matter of the normal textures, after growing and multiplying to a great extent, has ceased to exist."

Still more distinct evidence is furnished by Drs. Braidwood and Vacher's observations. They state in their "First Contribution to the Life History of Contagium," that the corpuscles, whose multiplication forms one of the characteristic appearances produced by the vaccine virus, "are to be seen in the crypts or hair-follicles budding or throwing off minute, round, highly refractive bodies." Similar corpuscles, seen in sections of skin affected by variola, are stated by these observers to be noticed germinating or throwing off spores on the fourth day of the eruption. At this point we exhaust our positive knowledge of the origin and reproduction of contagium. As stated by Dr. Sanderson many years ago, "all microzymes are not contagia, but all contagia may be microzymes." All forms and varieties of bacteria seen in contagious fluids and in diseased tissues are not contagium particles; and this is the point which specially concerns us.

"From the presence of bacteria in a given fluid, we can postulate nothing as to its disease-producing properties" (remarks Dr. Maclagan). "The fluid may be full of bacteria, and yet be incapable of causing disturbance; it may contain few or none of them, and yet a single drop introduced into the circulation may give rise to a most virulent disease."

The next stage in this inquiry refers to the circumstances favorable to the propagation of contagium particles, and to those inimical to their reproduction. For the development of organisms, certain external conditions are necessary; they will not grow in very low temperatures, and are destroyed in very high; they cannot thrive without water, and largely appropriate nitrogen in their growth. But contagium particles require something (as yet unascertainable) additional to these. "We know," observes Dr. Maclagan, "that the contagium of typhus, besides requiring for its development the conditions requisite to the propagation of organisms, has need of something more, which it finds in the human body; that the contagium of measles also requires its own peculiar element, which is also found in the human body, and is quite different from the element appropriated by the typhus contagium; and so on with all the other contagia."

After the introduction into the animal economy of a poison or of a contagium a definite sequence of phenomena is noticed. Each has a definite and specific action; a certain time elapses after the reception of the substance into the system before morbid symptoms are developed; the severity of the symptoms varies with the dose of the substance introduced; the effects are modified by temperament or constitutional peculiarity on the part of the recipient; and after a time the substance is eliminated from the system. But the existence of so many definite and distinct contagious diseases proves that the poisons which give rise to them are specifically distinct.

The view most generally accepted at the present time to explain febrile increase of temperature is that of Professor Virchow, which attributes this phenomenon to increased tissue change. According to this theory, "fever consists essentially in elevation of temperature, which must arise from an increased consumption of tissue, and appears to have its immediate cause in alterations of the nervous system"; but, as Dr. Maclagan remarks, this theory "serves to indicate rather than to explain" this febrile condition. "Why is there increased consumption of tissue? and why should the nervous system exercise other than its usual and normal action?" The reply to these queries would carry us a step further back than the point from which Virchow starts, but even then a constant and essential feature of the febrile state, viz., increased consumption of water, would remain unexplained. The late Dr. Parkes, who confirmed and ably elaborated Virchow's theory, endeavored to account for this last febrile phenomenon by supposing the existence in the blood of some substance which has an unusual attraction for water. He conjectured that this substance "may be some gelatinous compound which is formed in the rapid metamorphosis of the albuminous tissues, and which is ultimately converted into urea and uric acid;" but, as argued in the monograph under review, "why is this gelatinous compound formed in such enormous quantity as it must be to cause so great a consumption of water? and what becomes of the urea and uric acid into which it is ultimately resolved?"

To give a satisfactory reply to such queries as these, which crop up the more closely we study the subject, it is necessary to abandon Virchow's view and seek for an explanation elsewhere. The late Professor Traube, in 1863, ascribed febrile heat, not to increased production, but to increased retention of heat, consequent on contraction of the minute arteries, an hypothesis the inaccuracy of which has been demonstrated since then by Liebermeister and Leyden. Later (1873), Senator has stated "that there are periodic diminutions of loss of heat, together with a constant though not great increase of heat production." The former he attributes to occasional contraction of the minute vessels resulting from the action of the fever-cause, the latter he attributes to increased oxidation. Thus we find one further problem to embarrass the inquiry. As Dr. B. Sanderson remarks (A, Appendix, in the "Reports of the Medical Officer of the Privy Council," No. vi., 1875), to explain the nature of fever and its relation to the febrile process two possibilities are open to us: "One is, that fever originates in disorder of the nervous centres, that by means of the influence of the systemic functions the liberation of heat at the surface of the body is controlled or restrained, so that by retention the temperature rises, and finally that the increased temperature so produced acts on the living substance of the body so as to disorder its nutrition. The other alternative is, that fever originates in the living tissues, that it is from first to last a disorder of protoplasm, and that all the systemic disturbances are secondary. By both hypotheses it is tacitly assumed that fever is the product of a material fever-producing cause contained in the blood or tissue-juice, the morbific action of which on the organism is antecedent to all functional disturbances whatever." This leads us to the same conclusion as that arrived at by Dr. Maclagan, that fever "is a collection of different and various phenomena, all of which are abnormal, and all of which are developed subsequently to the reception of the contagium, and the co-existence of which in the body is conveniently characterized by the term fever."

The contagium being, then, the cause of the fever, becomes the cause of the individual phenomena which constitute the febrile state. To understand our position, it must be borne in mind that each of the minute organisms—contagium particles—reproduces myriads of similar organisms, and in so doing appropriates for their growth elements requisite for the nutrition of the body in which they grow. Here we have a starting-point, from which, by careful logical reasoning, the various phenomena of the febrile condition are gradually evolved by Dr. Maclagan. He shows clearly that the nitrogen essential for the vitality of the contagium particles is derived from the constructive store, the albumen of the tissues, "that this consumption of nitrogen by the contagium particles is the primary cause of the rapid wasting of the nitrogenous tissues which takes place during fever," that the agency which thus eats up the tissues acts also in diminishing their nutritive supply. "Blood continues," he remarks, "to be supplied to and to circulate through the tissues, but it is blood charged with an organism which utilizes for its own ends the materials which ought to go to nourish and build up the body." Moreover, not only do the contagium particles use up an excessive amount of nitrogen in their growth and deteriorate the blood, but they also consume water in large quantity, thus deranging nutrition and diminishing the bulk of the tissues.

Further and very valuable evidence in favor of this explanation of the most important phenomenon characterizing fever Dr. Maclagan derives from Salkowski's observations on the elimination of potass and soda during fever. Salkowski found that "the quantity of potass eliminated on a febrile day was three or four times, sometimes as much as seven times, greater than on a non-febrile day;" and that "the soda discharge was reduced to a minimum during the febrile state, and rose again when the fever had ceased." Now, potass exists in largest quantity in the muscles and blood-corpuscles, while the chief seat of soda is the liquor sanguinis. The contagium particles, then, according to the experimental evidence quoted, consume the nitrogen, water and potassium salts of the constructive store albumen found in muscle and blood; and this affords a full explanation of the wasting and irregular elimination of urea which characterize the febrile state. According to Dr. Burdon Sanderson (ibid. cit.) clinical observations show—"That in the early stage of fever a patient excretes about three times as much urea as he would do on the same diet if he were in health; the difference between the fevered and the healthy body consisting chiefly in this, that whereas the former discharges a quantity of nitrogen equal to that taken in, the latter wastes the store of nitrogen contained in its own tissues."—*British and Foreign Medico-Chirurgical Review.*

FOREIGN BODIES IN THE ŒSOPHAGUS.

The following is the substance of a paper read by Prof B. VON LANGENBECK to the Berlin Medical Society. After indicating the usual places where foreign bodies are detained in the œsophagus, the Professor went on to say (*Berliner Klin. Woch.*, Dec. 17 and 24) that he had met with three cases in which voluminous bodies detained in the pharynx by compressing the epiglottis against the rima glottidis threatened to produce immediate suffocation. The first of these was produced in the lecturer's presence, by a boy playing with another at catching a small apple thrown into his mouth. After succeeding several times, he suddenly fell on the floor with widely-opened mouth and a blue-colored face. Fortunately, it was found that the apple could be extracted by introducing the forefinger beside it. The second case occurred in the person of a very robust gentleman, who came to consult the lecturer concerning a hernia. Lying down on a sofa in order that it might be examined, he suddenly became lifeless and blue in the face. On the forefinger being introduced, a complete set of false teeth was withdrawn, the pulse and respiration, however, not returning until some seconds afterwards. Dieffenbach relates an entirely similar case. In the third instance, a lady, about to undergo amputation of the breast, exhibited at the very commencement of the administration of chloroform laborious stertorous breathing and a dark-blue color of the face. The finger, introduced to draw the tongue forwards, detected and withdrew a set of false teeth. In other cases of this kind the patients do not always escape so easily;

and it is very desirable that dentists should caution those to whom they supply teeth in order to prevent these accidents. Surgeons, too, before administering chloroform to elderly people, should ascertain with certainty the existence of false teeth, and insist upon their removal. In the removal of large foreign bodies the finger is the instrument to be resorted to before all others; and if they are too firmly fixed to be removed by it, then forceps or levers should be used. Tracheotomy is always too late in such cases. When, also, small-pointed foreign bodies—as needles, fish-bones, etc.—are detained in the pharynx, and especially in the sacculi formed by the ligamenta glosso-epiglottica, the finger should never be omitted to be introduced, in the hope of bringing the body into the mouth, or at all events to ascertain its exact position before employing the forceps.

When a foreign body of some size, as a large piece of meat, hard dumpling, potato, etc., passes through the pharynx, it not unfrequently becomes detained in the œsophagus opposite the cricoid cartilage, and by pressure on the larynx or trachea causes great difficulty of respiration. Its position is easily ascertained by the projection it causes on the left side of the throat, but its removal is often very troublesome, owing to the spasmodic contraction of the œsophagus which takes place above and below the foreign body. Forcibly thrusting it down cannot be too strongly deprecated, as injury to the œsophagus cannot be avoided with certainty. A peasant applied to the lecturer for relief, having thirty hours before attempted to swallow a huge piece of sinewy meat, which, being retained, almost induced suffocation. Repeated attempts were made to remove the foreign body by means of a slightly curved, strong forceps, but it proved immovable, only some of the fleshy fibres coming away. Œsophagotomy was contemplated, as during the attempts at removal the difficulty of respiration was so greatly increased; but the projecting tumor having been seized by the fingers in the neck, raised from the larynx and compressed for some minutes, the respiration became much more free. The foreign body, although not moving from the spot, had assumed, through this manipulation, a more elongated form, and was removed by means of the forceps with some exertion of force. Another man applied on account of the obstruction to respiration and swallowing caused by a pretty large piece of tough meat which had for twenty-four hours obstructed the same part of the œsophagus. Violent retching, caused by tickling the fauces, and attempts with the forceps to withdraw or thrust it down, failed to dislodge the body, which was placed as in a diverticulum of the left side of the œsophagus. The tumor which it formed in the neck was then seized with the fingers and squeezed so powerfully that the body slid down into the stomach. Dupuytren dealt with a potato in the same way, which had resisted all attempts to withdraw it or force it into the stomach. When the position of the foreign body is not indicated by its projection in the neck, we must bear in mind that the indications furnished by the patients themselves are very deceptive. Oftentimes they are unable to denote its locality, and sometimes assign one that is far distant from the real one. Thus, a woman in whom a set of teeth was lodged opposite the cricoid indicated the cardia, and a man referred the obstruction caused by a piece of bone to the cervical portion of the œsophagus, when it really existed in the thoracic portion. Catheterism of the œsophagus may therefore be required to ascertain the situation of the body. The general and almost traditional practice of employing the probang, either for the withdrawal or for the thrusting down of the foreign body, cannot be too earnestly deprecated. A more irrational practice can scarcely be imagined, and no other instrument has done so much mischief in proportion to the number of cases in which it has been employed. By it we are able to ascertain neither the situation nor condition of the foreign body; and, in place of its withdrawal or propulsion, it sometimes becomes only forced deeper into the œsophagus, and may even (as in two cases which the lecturer has met with) be thrust through the wall of the œsophagus into the mediastinum. When soft bodies obstruct the œsophagus, the forcing of which into the stomach is desirable, the probang may be used, but in all cases when the condition and position of these are unknown, or their extraction seems possible, catheterism must be first performed. For this purpose Prof. von Langenbeck uses a whalebone staff, to the lower end of which is attached a smooth polished iron ball. This, when well oiled, slides readily down the œsophagus by its own weight, is easily movable to and fro, and enables us to detect with certainty hard bodies, such as coins, needles, and pieces of bone. If the object is to force into the stomach a harmless substance, the nature of which is known, he employs an elastic œsophageal sound; this acts upon the foreign body as efficaciously as the probang, but slides down the œsophagus far more easily, and renders injury much less possible. Foreign bodies which may wound the œsophagus, or become dangerous in the intestinal canal—such as bones, fragments of glass, coins, needles, etc., should, in Prof. von Langenbeck's opinion, be always extracted, their extraction being a far more certain and less dangerous procedure than forcing them into the stomach. In a great number of such operations he has never met with any accident. The instrument which he exclusively employs for this purpose is Von Graefe's coin-extractor. This passes with facility, and without any injury, into the œsophagus beside the foreign body, and during its withdrawal seizes it with a certainty that leaves nothing to be desired. Prior to its introduction, some oil should be injected into the œsophagus, and then the end of the instrument should be guided by the left forefinger over the root of the tongue and epiglottis against the back of the pharynx, and thence into the tube. On withdrawing it very carefully, if the least resistance is encountered we must desist, and move it gently to and fro in order to disengage it from any possible entanglement in the mucous membrane. When the instrument with the foreign body has arrived opposite the cricoid cartilage, difficulty in completing the extraction is caused by the cartilage springing backwards; but this may be obviated by pressing the end of the instrument, which has now become visible, against the posterior wall of the pharynx. When the isthmus of the fauces has been reached, we should always, and especially with restless children, have the left forefinger in readiness, in order to seize hold of the foreign body, which might otherwise escape. A pair of firmly grasping pharyngeal forceps, and this coin-extractor, constitute all the apparatus required. There is, however, one inconvenience attending the coin-extractor that must be noticed, viz., when the foreign body becomes so firmly wedged into the extractor that this cannot be loosened from it and withdrawn. Prof. Adelmann relates a case in which the extractor, thus embracing the foreign body, could not be removed during two days. In the case of a girl who had swallowed a shawl-pin, which occurred to the lecturer, its position at the lower end of the œsophagus having been detected by means of the sound armed with the iron knob, it was seized by the coin-extractor. So firmly, however, had it penetrated the œsophagus that it could not be withdrawn; and, after repeated efforts, when the attempt was abandoned, the instrument could not be separated from the pin until after half an hour, when the pin slipped into the stomach. Bloody stools followed, and the patient complained of great pain in the stomach for a month after the accident, but the pin has never been found.

Casting one's eye over the statistics, it would be concluded that the passage of foreign bodies into the œsophagus is a very dangerous occurrence; for, of the 314 cases collected by Adelmann, 109 proved fatal. But the proportion of fatal cases is far less than this, for the great majority of cases, when the foreign body is easily extracted or passes into the stomach, are never published at all. In Prof. Langenbeck's thirty-four years' practice he has had a very great number of these cases, and has never met with a fatal occurrence. Pieces of money can always be removed, and some of the pieces of bone slip into the stomach as soon as they have been dislodged by the extractor; but the great majority of flat and pointed pieces of bone are removed. In the two fatal cases of perforation of the œsophagus related by Prof. Busch, the sponge probang had been employed, and the foreign body could not be detected. However, from this statistic the conclusion is to be drawn that if the foreign bodies be not promptly removed, and if unsuitable and violent manipulations are employed, they may seriously endanger life. Above all things, it is important that the body be removed as soon as possible, and that the practitioner at once proceed with decision.

When the removal cannot be accomplished, and the nature of the body does not admit of its being thrust into the stomach, when the cervical œsophagus is the part of the tube concerned, we should perform œsophagotomy. It is a comparatively rare operation, for, according to König, from the time of its first performance by Goursault in 1738, to 1872, it has been executed only twenty-six times for the removal of foreign bodies. Its indication has been generally believed only rarely to occur, while its danger and difficulty have been exaggerated: and an examination of the recorded cases of foreign bodies in the œsophagus shows that it should have been performed much more frequently, and that, without doubt, many lives might have been saved by it. The twenty-six operations referred to by König, and two now related by the lecturer, were followed by twenty-three recoveries and five deaths, some of the latter being due to the too prolonged residence of the body; so that the operation must be regarded as one attended with very little danger. Almost all living surgeons agree that the mode of making the incisions recommended by Guattani is the best, the skin on the left side of the neck being divided from the middle of the thyroid cartilage to the anterior edge of the sterno-cleido-mastoid, and to about five centimetres above the manubrium sterni. After the superficial fascia has been divided, the sterno-cleido is drawn outwards and backwards by means of double hooks, and the common carotid then becomes visible through the middle cervical fascia. The fascia is to be divided in the direction of the long axis of the wound, and drawn outwards and backwards by means of strong hooks, the carotid being kept out of the operation field. It must not be forgotten that this artery lies more superficially than the œsophagus, and that the latter only becomes visible after the deep cervical fascia has been divided. This is done at the outer edge of the sterno-thyroid muscle, after having drawn the larynx by means of a hook to the right side. The muscle being now drawn towards the median line, the œsophagus becomes visible. Before opening it an œsophageal sound, made of gum-elastic or pliable metal, should be introduced for the purpose of projecting the œsophagus more to the left, and rendering its opening more easy and certain. The separation of the fascia in order to expose the œsophagus is best accomplished by raising it by means of two hook-forceps, and dividing it between them, allowing the knife to act more by its pressure, thus avoiding injury to the inferior thyroid artery and inferior laryngeal nerve. Injury to the recurrent nerve is not much to be feared, as this passes upwards between the trachea and œsophagus, and is with the former organ drawn towards the right; it is only in question when a foreign body of large circumference thrusts the œsophagus far towards the left. The nearer an operation approaches important organs, the more must it assume the character of a delicate anatomical dissection; and in order to avoid injuring important vessels, it is highly desirable to separate the tissues as much as possible by means of the fingers or blunt instruments. When the foreign body does not project the œsophagus, and cannot be felt externally, the passage of an œsophageal sound by the mouth very much facilitates the operation. One circumstance may render access to the œsophagus exceedingly difficult, and is of the more importance, inasmuch as it is not noticed in any of the descriptions of the operation. This is the tumefaction of the thyroid gland. If a large foreign body be detained for several days opposite the cricoid cartilage, causing difficulty of respiration by pressure on the larynx, swelling of the thyroid, due to a stasis of the blood in the veins, is always present. The tumefied gland lies so much over the œsophagus that this may be entirely covered by it; and in order that the gland may be raised from the œsophagus its enveloping fascia must be divided.

Prof. von Langenbeck terminates his communication by the narration of two cases in which he performed œsophagotomy with success for the removal of false teeth.—*Med. Times and Gaz.*

Items.

EXTIRPATION OF THE LARYNX.—The report of the case from which Dr. Foulis removed the larynx has already been carried forward to the thirteenth day after the operation. Four months later, the patient had returned home with a good voice and in improved general health. As soon as the wound was in condition, an attempt was made to introduce Gussenbauer's voice-tube; but, owing to the shape and small size of the tube, and the undue contraction of the upper portion of the wound, the result was unsatisfactory. Dilatation of the contracted part, by means of the finger, was now actively pushed, and in the meanwhile a tube was made, after very considerable difficulty, to fit the wound. This tube was a modification of Gussenbauer's, but only in shape and in the position of the reed, the principle of the two being identical. During ordinary breathing no sound is emitted from the tube; but in forced expiration the reed is set in motion, and the sound thus produced is modulated into vowels and consonants by the mouth. So perfectly does this work, that, were it not for the monotony of the note, it would be impossible to distinguish anything extraordinary in the voice. By changing the reed the timbre of the voice, as well as the note, can be changed, and the patient amuses himself by making reeds of different materials—as wood, ivory, vulcanite, the metals, etc.; in this way he has at command a large assortment of voices to be chosen from at will. This seems to prove that the quality of the human voice depends more upon the density and elasticity of the vocal cords than upon the size and shape of the buccal cavity, though further experiments tend to show that this latter has some modifying effect. It is essential that the instrument should fit accurately, and this, at first, gave much difficulty, more especially the determining of the proper length of the ascending tube. If this be too long, the epiglottis closes imperfectly, reflex action is excited in the pharynx, and the increased secretions flow through the tube into the trachea, giving rise to troublesome and continued coughing; if too short, the soft parts fold over, and partially close the mouth of the tube, causing a muffling of the voice, similar to the effect produced by swollen tonsils, or any other swelling which encroaches on the pharynx, while the glottis remains healthy.

There is, as yet, no sign of the recurrence of the growth for which the larynx was removed; and the two glands, which before the operation were large and dangerous-looking, are now very small, but may still be felt on careful examination. The patient is still rather subject to colds, and during convalescence had a sharp attack of bronchitis, which, for a time, gave some anxiety; but he recovered well from this, and the lungs are apparently as sound as at the beginning of treatment.—*The Lancet.*

ABSCESSES CONNECTED WITH BONE.—*Hyperdistension with Carbolized Water.*—Not only may an abscess of a simple character be advantageously treated by hyperdistension with carbolized water, but one connected with bone even may be so treated, as shown by the case of a child with psoas abscess from carious spine. Having been placed under the influence of chloroform, an incision was made in the most prominent part of the swelling, and of sufficient size to admit one's finger. From this opening a large quantity of thick and healthy-looking pus escaped, and when the flow was becoming slow, the nozzle of a large syringe was introduced, and the cavity completely washed out with a warm solution of carbolic acid and water. The edges of the wound also having been held securely over the syringe, the cavity of the abscess was more than fully distended with the injection, which was allowed to be retained "while one with moderate haste might tell a hundred." A drainage tube having been introduced well up into the loins, and the wound covered up with oiled lint, the boy was sent back to bed. When I went to see him, an hour afterwards, he was half sitting up in bed playing with his toys, and talking to other children in the ward. The abscess was syringed out every other day. The discharge continued sanious after the second injection, and the case went on most satisfactorily. The great feature in this method of treatment of psoas abscess is its simplicity, and the absence of all special and intricate dressings. All that are required being a scalpel, the warm solution of carbolic acid, of the strength of one part in thirty, an ordinary enema syringe, a long probe, and a drainage tube. The best dressing consists in fine picked oakum, for soaking up the subsequent discharges, and a bandage.—*Braithwaite's Retrospect, from the Medical Press and Circular.*

FACIAL NEURALGIA.—*Nitrite of Amyl.*—I was consulted by a lady who, for a fortnight, had been suffering from severe facial neuralgia, which had resisted various remedies that had been employed before she came under my care. I advised her to drop five minims of nitrite of amyl on blotting-paper, and to inhale the vapor. The pain was rapidly and completely subdued. In a few hours it returned in a milder degree, and it was again promptly removed by the amyl vapor, and, after three or four repetitions of the dose, the cure was complete.—*Braithwaite's Rerospect*, *from the British Medical Journal.*

COMPENSATION OF MEDICAL EXPERTS.—The Supreme Court of Indiana rendered a decision last month (February) of immeasurable importance, not only to the medical profession, but to the members of the other professions and callings. It was a test case, and is the first decision ever rendered on the subject by any court in this country, and, as far as we know, in any other country, and will be hailed all over the land as just and right. The particulars of the suit are briefly these: Dr. T. J. Dills and A. B. Buchman, of Fort Wayne, Indiana, practicing physicians of reputation, were summoned by the defendant to give testimony, as experts, in a case of rape—State *vs.* Hamilton. They had no concern or interest in the case or man, and they refused to give the evidence unless they were properly compensated. The judge promptly ordered them to jail, and after they had exhausted every means to sustain the stand they had taken, they were forced to succumb, and give the testimony, which they did under protest, and then they brought suit against the State. A decision was given in the lower court adverse to Drs. Dill and Buchman, but the Supreme Court of the State reversed the decision of the lower court, and sustained the position taken by these physicians. The Court "held that, under the constitution, the State has no right to take a man's particular services without compensation; and that the giving of expert medical testimony is a particular service within the meaning of the constitution."—*Kentucky Advocate.*

BACTERIA AT LOW TEMPERATURES.—While the action of high temperatures on bacteria has been much studied, little attention has been given to their capability of resisting low temperatures. It has been found that at 0° C. they fall into a state of rigidity; but even at —18° to —25° they are not killed. M. Fisch, of the Vienna Academy, recently experimented with temperatures got from solid carbonic acid, exposing to these both putrefactive bacteria, and those forms of coccus and bacteria which arise in diseased products in the living body. The liquid containing the bacteria was put into thin test-tubes, which were closed with wadding, and surrounded by solid carbonic acid (in beaker glasses), on which ether was poured. The temperature sank to —87.5°, and gradually rose again in 2½ hours to 0°. The result of these experiments was that all the bacteria, tested successfully, resisted these low temperatures, and immediately after proved capable of vegetating rapidly in proper nutritive liquid. Whether the organisms would also withstand sudden changes of temperature was not ascertained. M. Fisch purposes experimenting in regard to this, and also to try the effect of still greater degrees of cold.—*Boston Journal of Chemistry.*

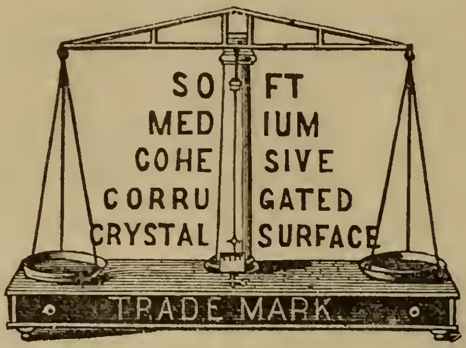
THE AMOUNT OF SALIVA SECRETED DURING MASTICATION.—M. Tuczek, in the last part of the *Zeitschrift f. Biologie*, relates his experiments on the amount of saliva secreted during the mastication of different kinds of food. The plan adopted was to take an ordinary mouthful of the substance, the quantity of water in which was known beforehand. It was masticated till judged fit to be swallowed, then ejected, weighed and dried. From the dry residue the quantity introduced into the mouth was calculated, and on subtracting this from the total weight of the ejected morsel, the amount of saliva added to it was obtained. The quantity of saliva secreted he finds is, as might be expected, greatest in dry food, as the crust of bread, where it amounts to somewhat more than the weight of the substance itself. He proceeds on the data so obtained to estimate the absolute amount of saliva secreted per diem, and gives the following table: Adult fed on black bread exclusively, 545 grammes; white bread, 698; non-nitrogenous food (starch, fat, sugar), 500; food with a larger proportion of bread and potatoes, 659; mixed food, 476; albuminous food, 773 grammes. On comparing these numbers with the total weight of the salivary gland (about 66 grammes), it appears that 100 grammes of salivary gland secrete in an hour about 1,300 grammes of saliva, which, in comparison with other glands of the body, shows that the salivary glands possess great activity.—*The Lancet.*

EUCALYPTUS AS A LOCAL ANÆSTHETIC.—Dr. Horton (Ohio State Dental Society) speaks of the extract of eucalyptus as producing good results as a pain obtunder in sensitive dentine. A drop on a pledget of cotton is used. He thinks it the best of the local applications.—*American Journal of Dental Science.*

In order to meet the frequent inquiries in regard to different kinds of gold of our manufacture, the following explanations are given. A careful perusal of this and the following pages may clear some point in regard to which you have doubt.

STANDARD

IN FINENESS,



IN QUALITY.

GOLD FOIL.

All gold bearing the above brand is, in the fullest sense, what it is named. It is STANDARD in FINENESS because it is, in every instance, most carefully refined under *our immediate* supervision, and only *chemically pure* agents are used in this process. It is STANDARD in QUALITY because the same care and attention which are used in the refining are continued throughout its manufacture. If any deviation is made from the above, either in regard to purity or quality, the name is correspondingly changed.

In the case of the *untrimmed* foil, which is sold at a lower price, there is the same care in refining, but less work in some of the other processes. The *Cylinder* Foil is refined just the same as the *Standard*, but a *slight* alloy is afterward added.

The greatest part of our own time is devoted to direct personal supervision and work in this department. Many dealers sell gold bearing their names as manufacturers, while in fact they have had nothing to do with its manufacture, and probably could not intelligently perform or supervise any of the different operations, and these are the men who will assure you the most positively that their gold is the best made. If the work could be just as well done by *contract*, we should be foolish to waste our own time.

R. S. WILLIAMS.

STANDARD

Cohesive Gold Foil.

Nos. 3, 4, 5, 6, 10, 20, 30, 40, 60.

This foil is often sufficiently cohesive without heating; but if from long keeping or other cause it has lost this quality, re-annealing will make it reliably cohesive, *except* in cases where it has been exposed to influences which may not be wholly removed by heat.

Annealing should be done judiciously. With thin numbers, as 3, 4, 5 and 6, used as pellets, it is not always necessary to heat to redness, as this causes it to ball up and rock from its first position, while a lower heat will usually give sufficient cohesiveness and less harshness. A few trials, beginning with a low heat, will indicate what degree is needed. If the foil is folded smoothly, or a thick number is used in single thicknesses, a higher heat can be used to advantage.

When gold is to be used strictly cohesively, as for contours or surfaces, it is only justice to the manufacturer to use what is labeled or known to be cohesive.

R. S. WILLIAMS.

STANDARD

Medium Gold Foil.

Nos. 4, 5 and 6.

When freshly made, and used without annealing, this foil has a very soft feeling and yet seems cohesive under pressure. It is important to have this fresh, because it is very susceptible to changes. If necessary to anneal, use a very low heat, particularly if it is intended to preserve the *medium* quality; a high heat will make it nearly the same as the cohesive.

R. S. WILLIAMS.

STANDARD

Soft Gold Foil.

Nos. 4, 5 and 6.

The peculiarity of the above is, that while no alloy is used, and it is as pure as the cohesive, yet it is sent out in such a condition that the surfaces will readily slide on each other, working soft under the instrument, and only consolidating under heavy pressure. If used strictly as a soft foil, very little heat should be used; if annealing is needed, a slight *warming* is generally all that is required. A higher heat will make it considerably cohesive.

If a person wishes to use only one kind of foil for all cases, we should recommend this as the best we could make; yet it has been our practice, for some time past, to recommend for *surfaces and contours*, *gold which is regularly cohesive.*

R. S. WILLIAMS.

STANDARD

CARBONIZED GOLD FOIL.

Nos. 4, 5 and 6.

Pat. Jan. 25th, 1876.

This is *soft*, *waxy*, and, if annealed, moderately cohesive, without becoming stiff.

It is a soft foil without any alloy, but has a *slight* deposit of pure carbon on the surface, to prevent too rapid cohesion.

As carbon is a pure substance, and subject to no change in the mouth, there seems to be no possible objection to its use.

One property is worth mentioning. If a piece of this foil is rolled up into a ball or pellet and annealed, the carbon inside will be scarcely changed at all, while on the surface it will be partially consumed by contact with the heat of the flame and the oxygen of the air. Of course this gives a greater degree of softness inside, and a greater degree of cohesiveness outside—a combination which is often desirable.

R. S. WILLIAMS.

STANDARD

Corrugated Gold Foil.

Nos. 4, 5 and 6.

This has a peculiarly beautiful, roughened surface. From the process of manufacture it is very soft, and, when annealed, cohesive enough for all except extreme cases.

It will generally stand for surfaces and contours, but it is liable to wear rough, and is not recommended for these uses. For rapid and efficient use inside of cavities it is admirable.

Annealing to redness does not injure its working qualities so much as is the case with other kinds—it does not readily stiffen.

R. S. WILLIAMS.

STANDARD

CRYSTAL SURFACE GOLD FOIL.

Rolled (Cohesive). Nos. 30, 40, 60 and 120.

Pat. June 21st, 1870.

This is rolled only, not beaten. After the rolling is completed, the whole outside surface is dissolved off with Aqua Regia, this giving what is found in no other gold—an absolutely clean and pure surface. The process of dissolving leaves the surface slightly irregular, and discloses the crystalline structure of the gold—hence its name. This peculiar surface and its purity give it a remarkable cohesiveness. As this is generally used either in single thicknesses or folded flat, there is no objection to annealing to a *full red* heat, or to any point short of the melting point.

For *contours, surfaces, cases where great strength or cohesiveness* are required, we recommend this more highly than any other gold.

R. S. WILLIAMS.

CYLINDER GOLD FOIL.

4, 5, 6, and Higher Nos. if Needed.

Pat. Jan. 25th, 1876, and Oct. 31st, 1876.

It is first refined the same as the *Standard* Foil, and afterwards a *slight* alloy is added, which, although so small as to be hardly worth mentioning, forms an oxide on the surface, and prevents the too rapid cohesion of the surfaces when brought into contact.

It is soft *per se,* and works differently from other gold in all the process. Annealing will make it somewhat sticky, but not fully cohesive, and it can be made *non-cohesive.*

Some of my best customers approve this gold highly. It is particularly useful in making old-fashioned cylinders and cylinders style B (hence its name), as well as for general use as a soft foil.

R. S. WILLIAMS.

General Directions for Annealing.

Annealing is best accomplished by placing the Gold upon a sheet of thin Mica, and holding it over the flame of a spirit lamp or a Bunsen Burner. As Foil is often injured in annealing, and rendered harsh and unsuitable for the operation in hand, the following general directions are given:

If it is necessary to anneal this Foil, it is better to first *warm* a small piece and see what the effect is; if that is not sufficient, take another piece and *heat* it *slightly.* A few trials in this way will determine the degree of heat required to produce the proper working qualities.

Of course if the Foil is adhesive, and it is desired to use it strictly as such, a thorough annealing will be required. If the Foil is soft, and it is to be used as soft Foil, try it first without annealing, and then, if necessary, *warm slightly.* If much heat is used, this soft Foil will become adhesive.

Heavy Foils, Nos. 10, 20, 30, 60, etc., need thorough annealing before using—in many cases even heating to whiteness will be advantageous.

R. S. WILLIAMS.

Dental and Oral Science Magazine

No. 3. AUGUST, 1878. Vol. 1.

New York Odontological Society.

Regular Meeting, April 16th, 1878.

The meeting was called to order at 8 o'clock, P. M , the President in the chair. Upon "Incidents of Practice" being called,—

Dr. George A. Mills (*Brooklyn, N. Y.*): A lady of delicate organization came to me for treatment of a second molar, the crown of which was broken off, and with violent periostitis in progress. The lady being *enceinte*, her husband had doubts as to the propriety of extracting the tooth; nor did I wish to do so. I drilled directly through the root, drawing blood with the drill. There was no suppuration. As the pain was very severe, I gave her thirty-five drops of wine of opium, kept her in the parlor for half an hour, and then dismissed her, relieved from pain.

Dr. Palmer (*New York*): I had a case in which the right superior first molar had been devitalized, the pulp chamber filled, and the tooth used for a considerable time, until the crown gave way, leaving the three roots in place, but with the anterior buccal root separated from the two others. A crown for this tooth was necessary, in order to prevent too much force being exercised upon the anterior teeth in occlusion. I took an impression, made a plaster model, and fitted three straight screws, one to each root, and projecting above the root surface. Resort was had to hippopotamus ivory for an artificial crown, as no porcelain teeth to be procured would fit the case. The artificial crown was fitted accurately to the root-margins, and had an undercut in its base which opened through to the grinding surface. Then, the crown being set in place over the roots and screws, amalgam was packed in around the screws, filling the cavity. After more than a year's good service, a portion of the amalgam was cut out and replaced with gold. The operation is in my own mouth, and has, so far, done good service for more than two years.

Dr. A. C. Hawes (*New York*): A little girl, some five years old, was brought to my office crying bitterly with pain. Upon examination, I found a temporary molar in the lower jaw which was considerably decayed in the crown, the decay appearing to extend to the pulp. The application of almost every remedy I could think of did not allay the pain. Finally I drilled through the decayed covering to the pulp, and the child immediately stopped crying, and was almost asleep from exhaustion in five minutes. The nerve had died in its cavity, and the imprisoned gases caused her agony; but the opening for their escape made by the drill gave her instant relief.

(Dr. O. E. Hill, of Brooklyn, rose to speak of certain incorrect reports of the Society's proceedings, which had been published in foreign and home dental journals. In the course of his remarks he read extracts from the journals named. The Secretary also read from the stenographer's notes of the proceedings in question. The Society then took official action on the matter, in the form of resolutions, which have already been printed on page 151 of the May number of the Dental and Oral Science Magazine. On page 154 of the same number may also be found the extracts read from the stenographer's notes.)

Dr. St. George Elliott then presented a number of dental appliances to the Society, describing them as follows:

Dr. St. George Elliott: In attempting to overcome little practical obstructions, one is often led into channels which, while of interest to the person at work, do not possess any very great intrinsic value. This is, perhaps, true of what may be called amalgam fillers or pluggers, of which I have made four or five. The most recent form resembles a hammer, having one small and one larger head, allowing the packing of larger or smaller amounts of amalgam. The simplest form I have yet made consists of a hatchet excavator, the head being at an angle of 45° with the shaft, and having a small hole drilled in one side. The amalgam clings to this hole just sufficiently to allow of being carried to place, yet not enough to hinder subsequent manipulations by "sticking."

Some time ago I brought to your notice a foot-power pneumatic mallet. Since then I have improved upon the first model somewhat, and now find the instrument very useful, when compared with the spring automatic mallets, though not with the lead or electric mallets. The bulb, though made of much heavier and harder rubber, and working much better than formerly, still failed to drive the mallet with sufficient rapidity for many cases, except when accompanied by great oscillation of the apparatus. Therefore I abandoned entirely the pneumatic principle, and now connect the follower with the cable of the dental engine by small gears, the follower striking upon a washer of rubber, which intervenes between it and the plunger. The rubber gives a springing blow. Pressure upon the point increases the force of the blow, by holding the plunger further up the tube against the follower. In connection with this appliance I would call attention to a device for upholding and steadying the arm of the engine. It is a simple flat steel spring, fastened at one end to the upright standard, and running out under the flexible arm, to which it is again fastened at its other end. This holds the arm extended, prevents vibration, in a measure, and obviates the sagging or dropping of the arm between the end of the hand-piece and the bearing on the standard.

Celluloid, whatever its merits in the mouth, certainly makes excellent handles for instruments. It is very light, and sufficiently strong for ordinary purposes; though where much force is to be used I would reinforce by running a metal rod lengthwise through it. I have here a double-end exploring instrument, with celluloid handle. The points turn in opposite ways, for use in different directions.

Here is a rubber-dam buckle, a modification of Dr. Perry's, made of wire curved to the shape of the cheek, and having four points.

For producing an intense heat, sufficient to melt brass or gold, I have made a compound burner, which consists of thirty-three ordinary Bunsen tubes, ranged in a circular conical arrangement. A chimney fitted to it may contain a crucible. This is a very powerful burner.

The following paper was then read by the Secretary:

RELATIONS OF THE DENTAL PULP TO THE OTHER TOOTH TISSUES.

BY L. C. INGERSOLL, KEOKUK, IOWA.

Any attempt to pass judgment on the relative value of things essential to life or existence is as futile as the decision of the question in the school-boy lyceum, "Which is most essential to the well-being of man—air or water?" To decide the question on its merits, in favor of either side, is to nullify unanswerable arguments on the other side.

If we assume that the relation of the tissues of the teeth is as absolute as the component elements of air or water; if the tooth pulp is, at all ages of the individual and in all its vital conditions, a *sine qua non* of tooth structure, as hydrogen is of water, there is no debatable ground on which to plant a doubt. But, on the other hand, if it can be shown that it is not absolute and unchanging in its relations, but variable with age and its own vital conditions, we may pertinently ask, What are its changed conditions and its changed relations to the other tooth tissues, and how should the facts evolved modify our practice?

Dentists everywhere have encountered the popular opinion that when the nerve or pulp of a tooth dies the remaining tooth substance is soon lost. How generally this popular opinion has domiciliated itself in the minds of the dental profession is told in the universal interest which the subject of pulp preservation has elicited during the last twenty-five years. It was also made quite evident at the last meeting of the American Dental Association, when the writer of this paper broached the subject now offered for your consideration. We often find ourselves holding opinions of which we can give little or no account as to how we became possessed of them, except that such are the common belief. A hundred men will walk in the same devious path through the snow, without being able to give any reason for their course farther than that found in the fact that they are following the tracks of the first man that passed along that way after snow-fall. Opinions, notions and tissues of thought are entailed upon us like many of our physical idiosyncrasies. We believe and adopt them because our seniors believed and adopted them. In this era of progress and evolution, a decade of years should not pass without a retrospect of our thoughts and opinions, to determine whether they are founded in fact or in fancy. The learned among the Greeks handed down to their posterity fables as well as facts. In our day we have to deal with ancestral foibles rather than fables.

In undertaking to solve the problem of the functional value of the pulp at different periods in life, and in its varying vital and pathological conditions, I desire first to call your attention to a few accepted facts.

The function of the pulp in developing the tooth is unquestioned. But what does development mean? It means something more than presenting the dental organs to view in the mouth. In this sense an ear of corn with well-expanded kernels is fully developed, while yet the husks are green. But the corn is yet in the milk; and even after the glazing of the kernel with its yellow enamel, there is a hardening process going on within to bring it to maturity. Teeth when they cut the gum are yet in "the milk." They must gain in density by a ripening process, not so much chemical as functional. When the teeth first appear, the soft tissue bears a much larger proportion to the hard tissue than later in life. There *is* a period when the developing dental structure in all its form and substance is *wholly* soft or animal tissue. But from the moment an atom or a molecule of calcifying matter becomes fixed in the periphery of the pulpy mass, this new element is an entity claiming space. Space previously occupied by soft tissue is relinquished to the hard tissue. Though it is quite possible that by prolification of cells the pulp for a while maintains its undiminished size, the limit of space renders it mathematically certain that at length the soft tissue must diminish in exact proportion as the hard tissue increases.

This supremacy of the hard tissue once gained, every month and every year lessens the size of the pulp by as much as the hard tissue has gained. *Mark well this tendency to obliteration of the pulp.* It is not a recession or retrogression under pathological influences, but under physiological law. When, therefore, you say that the dentine tubes are being filled up, or that the tube fibrils are being calcified, you are saying this—that the pulp is diminishing its area—that it is diminishing its territorial occupancy—that in the deserted territory the pulp has ceased its functions—that this is the process of pulp extinction. Every progressive step toward calcification of dentine is just so far a measure of the extinction of pulp substance and pulp function.

We all have observed that the pulp in the tooth of a youth is much larger than in the tooth of an adult. In harmony with this is the histological fact that the dentine tubes are much larger in early life than in adult life; also that other fact which has come to the observation of histologists, that odontoblast cells decrease in size and in number with the age of the tooth.

What is this steady decrease with advancing life, of the size of the dentine tubes, but a steady diminishing of the pulp and pulp influence? What is this increase of the mineral portion but a decrease of the animal and vital portion? What is this process of calcification of dentine fibrils, this encroachment of the walls of the pulp chamber upon the pulp itself, but progress towards pulp extinction? What is this process of mineralization of the teeth at the expense of the animal portion but an indication that the economy of nature is being so fully met *by mineralization* as to need less and less the functional power and nutrition of the pulp?

We have an example of more complete mineralization and annihilation of function in the enamel. It was once as wholly animal in its tissue, and as dependent upon vital functions, as the dentine. But by a process of more rapid development than dentine it passes almost wholly over from the organic kingdom to the mineral kingdom, and becomes in like degree independent of its early organic life. We thus see that the teeth occupy middle ground between the animal and the mineral kingdoms—neither belonging wholly to the one nor wholly to the other—being in their early organic nature wholly under the control of the animal functions, and in their later and more perfected state subject, in greater part, to the laws of the mineral kingdom. This is an important view of the subject, as shedding some light on the relative importance of the pulp at different periods of development of the dental structure. With the change of substance comes the changed relation of the animal to the mineral portion of the teeth.

The old physiologists numbered the teeth among the bones of the body. But when their peculiar structure came to be studied it was found that neither physiologically nor pathologically could they be called bones. Comparisons cannot be justly instituted between them and bone or any other internal structure. Teeth can more properly be classed with the dermal appendages. They are dermal *out*-growths and not *in*-

growths, and, like all out-growths, arrive at a measure of independence of that vitality so essential to all internal structures.

In the animal kingdom teeth are allied to horns, scales of fishes, the hard covering of some insects, and to all crustacea; and in their relations to vitality should be compared with these rather than with bones invested with flesh.

For a single illustration take the horns of a deer. The deer's horn has both an inner and an outer pulp. What is known as the "velvet" is the outer pulp. This is highly vascular and wonderfully active in its formative function. Its vessels communicate with the inner pulp through the hardening tissue of the horn as the nerve fibrils of teeth ramify the dentine. As the soft horn becomes mineralized, the canals, through which the outer and inner pulps communicate, are gradually filled up, till at length the outer pulp is cut off from its connection with the inner pulp, and dies. Then by the dictate of some animal instinct its bloody substance is rubbed off. Thus the outer portion of the horn is left without vital support and nutrition.

Tomes, in his Dental Anatomy, speaks of classes of teeth "in which the whole pulp is converted into solid material and no pulp cavity remains." [p. 79]. Then on the following page says: "The pulp of a sperm whale *becomes obliterated* by a development of secondary dentine." In speaking of the tusk of the elephant, which is probably as nearly identical with human dentine as any animal formation, he says [p. 323]: "The last remains of the pulp are converted into dentine in which a few vascular canals persist; these, of course, occupy the centre of the tusk, and are small in amount."

Of the teeth of rodentia, he says [p. 337]: "The last remains of the pulps are converted into secondary or osteo-dentine, which thus forms the central axis of the incisors or molars, as the case may be. In this tissue vascular tracts sometimes exist, but altogether small in amount; the formation of true dentine going on till the pulp at that particular point is almost obliterated." On page 339 he says of the same: "Near to the surface actually in wear they [*i. e.*, the dentinal tubes] become cut off from the pulp cavity, by the conversion of what remains of the pulp into a laminated granular mass, so that the dentine exposed on the surface of a rodent's tooth must be devoid of sensitiveness, and the contents of the dentinal tubes must have presumably undergone some change; but what the nature of the change in the contents of dentinal tubes which have ceased to be in continuity with a vascular living pulp may be, there are, so far as I know, no observations to indicate."

In his description of the teeth of the parrot-fish we read [p. 213]: "When calcification has proceeded so far as to obliterate their central pulp, cavities, etc."

The above facts lead us to the conclusion that the developmental process in the formation of dentine is continuous and towards perfectibility, and that perfectibility of dentine means a calcification of dentinal fibrils so complete as to wholly exclude vitality from the area so calcified. Notice, too, this completeness of calcification is not the result of formative action excited at indefinite intervals by irritation from without, or by any external influence, but is *inherent in the nature of the function*, and is a continual progression according to physiological law.

In the mouths of some persons this perfectibility of structure is greatly retarded or wholly prevented by diseased conditions, general or local. Operations on such teeth are always attended with pain, even after middle life of the patient. But the experience, even of a limited practice, brings convincing evidence of teeth in the mouths of persons of healthful organization that are entirely free from sensation throughout a large portion of their crowns, rendered so by a completed calcification. Such teeth are found in the mouths of many persons in middle life and on down to old age. We should be familiar with a larger number of cases of this kind, except that persons with such teeth seldom need the services of a dentist. By every test for vitality, such dentine, receiving no nutrient support from the pulp, is really dead. Yet every dentist reckons such teeth in the soundest possible condition, least disposed to decay. For this is the most complete tooth structure—complete in proportion to the obliteration of the pulp fibrils, thereby rendering such portion of the hard tissue independent of pulp influence.

Let us now examine the dental foramen to see if it does not teach us a lesson pointing to the same fact which I have been attempting to establish. We find that in childhood and in youth, during the period of most rapid development of tooth structure, the dental foramen is wide open, permitting the passage of many vascular canals, freighted with tooth material, for the building-up process. But with the progress of the work this gateway gradually closes. The dental foramen becomes smaller and smaller, till at length we find it scarcely perceptible to the unaided eye. Here there is a reduction of the capacity for nutrition in proportion to the demand of the structure for nutrient support, and further evidence of the diminishing importance of the pulp.

I propose now to consider some objections to the view here presented.

The objection which most readily finds utterance is that to which I have alluded as a popular impression, and accepted, too, by many of the profession, viz.: that the pulp is an absolute and essential factor, not only in the construction of the tooth, but in its preservation—that it holds its elements from dissolution. When popularly stated it is this: "When the nerve dies the tooth will rapidly decay." When stated by the profession it is this: "When the circulation of nutrient material has been cut off by destruction of the pulp, the dentine will surely tend to disintegration."

In answering the objection in the first form stated, I need only allude to the numerous cases of pulpless teeth standing in the mouth in all their integrity—save the decay that wasted them while the pulp was alive—and such teeth have so stood for many years. A little inquiry will bring to our notice, almost daily, in the mouths of our patients, teeth still firm that have been pulpless for ten, twenty or thirty years.

Should the pulp be devitalized in early life, all dentists would regard the chances of preservation of the remaining structure less favorable than when the devitalization occurs late in life, because of the greater porosity of the hard structure in early life. Yet the instances are numerous of boys and girls having teeth knocked loose by a blow or a fall, which perfectly destroyed the vitality of the pulps, and such teeth have been preserved, though greatly discolored, till advanced manhood or womanhood. Not long since I discovered two dark pulpless teeth in the mouth of one of my patients fifty-five years of age. On inquiry I learned that the accident occurred at fourteen years of age by the kick of a colt. These teeth were firm and free from decay. It needs but little inquiry to learn of cases sufficiently numerous to satisfy the popular mind on this point.

But to answer the objection in the second form stated, coming from the professional standpoint. I am aware of the preconceived notions and theories which persistently assert themselves, gaining strength by repetition. An objection, representing the views of a large number of the profession on an important point in theory and practice is worthy of a candid consideration.

The objection is based upon the nutrient function of the pulp. It is a commonly received opinion that there is a perpetual change of tissue throughout the entire organism—that it requires but a few years at most to effect so complete a change that not one atom of old tissue remains. This is an old doctrine. It antedates dentistry and dental science. Its proofs were given to the world before the peculiar structure and organization of the teeth were known, or even before it was well understood that they had anything peculiar in their organization and structure—anything to distinguish them from bones. Has modern investigation ever given any proofs that the teeth are subject to the law of waste and supply in common with other tissues of the body? We know that the organizing functions treat the teeth in a very different manner from bones to which they are nearest allied. Bones may be wasted by disease, portions removed by fracture, or cut away by a surgical operation, and the lost parts will be restored by the organizing functions. Not so the teeth. When wasted by disease, abrasion, erosion, or a dental operation, no part of the lost tissue of a tooth is ever replaced. Dentists sometimes talk about nutrition of enamel. Why, then, is the enamel organ counted out, after the emergence of the teeth from the gum, and no longer numbered among tooth tissues? Where is the possibility of organic function being carried on with but one per cent. or three per cent. of animal tisssue, while the ninety-seven or ninety-nine per cent. is of such crystalline density as to exhibit no more vascular trace than quartz? True, sensation has sometimes been discovered in the enamel, and an occasional dentine fibril has turned a loop up into the enamel. But what can such exceptional cases prove more than the possibilities of abnormal structure?

Nutrition implies consumption and waste of tissue through the activity of animal functions. Where there is no waste of material there is no necessity for replacement. A structure that is composed chiefly of perishable material, like the soft tissues of the body, must of necessity require perpetual supply of new material, which we call nutrition, else the whole structure is soon broken down. In proportion as the structure is built up of *imperishable* material—not absolutely such, but imperishable as it stands related to existence of the individual—in like proportion is the necessity for replacement by nutrition diminished.

The teeth are composed so largely of imperishable material, that it is not in accordance with the philosophy of organic life to presume, in the absence of incontestible proofs, that the hard and imperishable material would be replaced simply because the soft and perishable animal tissue is continually undergoing replacement. This would be a waste of vitality and function, of which Nature is never guilty. All observed facts point to the teeth as a peculiar structure, not subject, like other tissue, to the law of waste and supply, requiring the nutritive functions of the pulp only to preserve intact their perishable animal tissue.

Again, if the matured tooth in its undiminished whole needs the nutritive function and vital support of the pulp to preserve it from disintegration, every portion of the tooth needs it alike. Nature pursues a damaging course and greatly blunders when she calcifies the dentine fibrils, and thus cuts off sensation and vascular action from any portion of the dentine, if such connection with the pulp is *necessary* to preserve the integrity of the dentine. All dental observation is a defense of nature—for we find the most thoroughly calcified teeth to resist decay the longest. These hard, dense teeth, that can be drilled into and excavated without pain, are the most enduring dental structures known to us; while the teeth that have large pulps and large dentine fibrils, fully active for nutrition, but not for calcification, are teeth readily disintegrated, and which give no promise of long continuance.

Let us look still farther at portions of the dentine cut off from pulp nutrition by decay, instead of by the physiological process of calcification. In every tooth penetrated by extensive decay, many of the dentine tubes are cut off, and, of course, the outlying dentine is cut off from all *direct* communication with the pulp. But this does not necessarily cut off all pulp nutrition; for the plexus formed near the border line of the dentine and enamel by the anastomosis of the dentine tubes and the looping of pulp fibrils is adequate to sustain vitality, for a while, in every part of the peripheral portion of dentine. But in numerous cases of extensive decay we find some portions of the walls of the cavity void of sensation, by reason of the death of the pulp fibrils. And we are all familiar with the fact, too, that when found very sensitive, if such cavities are filled and reopened after six months or a year, we often find the fibrils dead, although the body of the pulp be yet in a condition of healthful activity and life; or the same non-sensitive condition of the walls of the cavity may have been brought about by calcification of the plexus. In either case, pulp nutrition is cut off from a portion of the dentine. And we are familiar with the further fact, that if such cavities are thoroughly filled, the whole tooth—including the devitalized portion—is preserved. Thousands upon thousands of such cases witness to the truth of this statement.

The conclusion is that, if part of a tooth in such condition may be preserved from disintegration, the whole tooth may, *under favorable conditions*, be preserved indefinitely from disintegration, though freed from pulp nutrition by the death of the pulp.

Another objection, or another form of the same objection, is found in the statement often made, that vitality protects the teeth from decay. Why, then, are the teeth not protected from decay? as they all have pulps. It is popularly said, too, that it is the special purpose of the enamel to preserve the teeth from decay. Why, then, with both these safeguards, are not the teeth protected from disintegration by caries? I take it that the teeth are enameled to protect them from abrasion—that they are enameled for the same reason that instruments made of iron are pointed with hardened steel, or case-hardened—to protect them from waste of substance by use, or to give them a cutting edge. Protection from decay is only an incidental and concomitant fact.

Protection from decay by vital action in the calcification of the dentine fibrils is in perfect harmony with the views here presented. But *arrest* of decay through vital action is of rare occurrence. Some have seemed to convey the idea in their remarks on this subject, that the *mere presence* of vitality inherent in a living pulp had some mysterious power to prevent the action of those agencies which produce decay. Facts are strongly against this notion. I need in this connection but to again refer to the rapid decay of youths' teeth from the age of fourteen to twenty, when they are in the condition of most active vitality. Another significant fact bearing on this point is that recent decay is seldom found in the non-vital portions of the teeth of old people; but you look for fresh decay about the necks of the teeth where vitality is still active in the dentine.

In suggesting any modification of practice based upon the positions which I have taken on the relations of the dental puld to the other tooth tissues, I am aware that the conservatism of the world is such that mankind are struck with alarm when any note is sounded not in harmony with cherished theories and adopted practice. For a number of years past we have been lulled to rest, concerning exposed pulps, by the narcotism of creosote and oxychloride of zinc.

The profession have been led to believe that the destruction of the pulp is well nigh equivalent to the destruction of the tooth; that therefore the slightest evidence of vitality lingering, however feebly, is a sufficient warrant for persistent treatment, ending with the oxychloride capping; and that such means are specific in restoring the healthful condition and functional activity of the pulp. Hope is a good thing—a most excellent quality of the mind, and *trust* for a realization of the thing hoped for is a counterpart of the same. But hope and trust must have a basis of facts sufficiently broad and deep, else hope and trust are not reasonable.

I ventured the opinion, at the last meeting of the American Dental Association, that we had hoped in many cases without good foundation, and trusted too implicitly in the treatment, and believed too confidently in results. I hold these opinions still. I would not have the profession abate one whit the desire, and the study and experiment, to preserve exposed and diseased tooth pulps. But I would have the profession diagnose more thoroughly their cases, observe more critically their successes, and modify their practice by a more careful judgment of physiological and pathological facts.

Dentists must acknowledge that the diagnosis of a diseased pulp is extremely difficult; not so much as to its present condition as to its vital power and susceptibility to treatment. If we bear in mind the facts as set forth in this paper, I think we shall conclude that the pulp has not a *tenacity of life*, except under the most favorable conditions. Its gradually diminishing substance and gradually diminishing functions, and its tendencies toward obliteration, should all be considered, and enter into a diagnostic opinion as to results of treatment.

I believe that a judgment based upon sensation, or the impression of pain, has led many a hopeful and anxious dentist astray. It is not a very uncommon occurrence to find teeth that have wasted away—the entire crown, including the pulp—without causing any serious pain or discomfort. The treatment of teeth having this tendency might greatly deceive an operator who trusted chiefly to sensation in making a diagnosis. This quiet condition of an exposed pulp is a fearfully morbid condition. To cap and fill over such a pulp because it is quiet enough to tolerate the presence of foreign material, as it has tolerated contact of the atmosphere and fluids of the mouth, will not arrest the tendency to devitalization. "Failure" may be written on the record in less than six months.

I would not even attempt treatment of pulps in this class of teeth.

Again, dentists are no doubt often deceived by the quieting influence of anodynes and narcotics. A patient comes into the office having a tooth that has often been the cause of severe pain. The dentist applies the remedy and almost instantly the pain ceases; and so long as it is kept narcotized it gives the patient rest. To assume, therefore, that this freedom from pain is evidence of health and restored function is a false assumption. It is no more evidence after five days or ten days than the first day.

While penning this part of my paper, two cases were presented at my office by a lady from a neighboring city. For three weeks she had been annoyed, and, at times, greatly distressed, with pain on the right side of her face. She identified the second superior bicuspid as the source of it. On examination I found her teeth well cared for, both personally and dentally. The teeth in that locality had been filled in a most skillful manner, so far as I could judge from external appearance.

The offending bicuspid had in it a large gold filling, inserted about a year and a half previous, also the first molar. I instituted inquiry to learn the facts and circumstances attending the operation. I learned that both teeth had been treated for supposed exposure or sensitiveness of the pulp, and capped with oxychloride of zinc. My diagnosis of the case was that in the bicuspid the pulp was in a high state of inflammation, involving the peridental membrane—that in the molar the pulp was wholly devitalized, decomposing, and abscess imminent on the palatine root. I drilled into the crowns of both teeth, found the capping as represented, and the pulps according to diagnosis, except that the pulp in the molar had not become as thoroughly disorganized as I anticipated.

No doubt these teeth stood on the record of a good operator marked "success." All painful sensation was allayed during his treatment and filling, and for months after. Suppose that the operator in these cases had considered the tendency of the pulp to obliteration, and the slight tenacity with which it holds its vitality when diseased, or disturbed even by slight causes, he might have judged it better, at *first,* to extirpate the pulps of these teeth, than to run the risk he did, though with his confidence in the popular treatment he *might not* have considered *any* risk.

Yet every dentist should consider the risk, in view of the large number of failures in the treatment. He should consider the many teeth in which the pulps have died when decay had penetrated the dentine but slightly, and the operator had never thought of any risk in filling.

How many of us have been surprised on examining such cases in one or two years after filling, to find the pulps dying or dead? He should consider the number of cases in which the death of the dental fibrils has caused disease or death of the pulp.

He should consider physical idiosyncrasies of the patient; the history of other cases, if any, in the same mouth; the complete or incomplete organization of the teeth.

Considering the points above enumerated, we may well conclude that of the cases needing treatment of any kind as a means of preserving the pulp alive, only the most favorable cases presented offer hope of *permanent* success—that a chronically congested pulp; a suppurating pulp, a tumefied pulp, a half-destroyed pulp, each and all such cases are extremely doubtful of results—so doubtful that the chances of the *permanent preservation of such teeth* are better by means of extirpation of the pulps than by any treatment at present adopted for their preservation.

The large number of cases of spontaneous death of the pulp *after treatment,* and the damaging effect of such death on the root membrane, should be a serious warning to every operator.

In the mouth of an adult individual a healthy, vigorous root membrane is of far more importance than an emasculated pulp. To endanger the normal condition of this membrane is a more sure endangering of the tooth than anything that can possibly happen to the pulp which does not necessarily involve the root membrane. How many teeth *with healthy vigorous pulps* are annually lost by a wasting away of the root membrane and alveolar processes ! And dentists are as yet able to offer but temporary check, except in few cases, to the progress of the disease. I would say, then, in all cases avoid a slow spontaneous death of the pulp if you would avoid a chronic disease of the root membrane.

It may be replied to this that extirpation of the pulp endangers in like manner the root membrane. I am aware of the delicate nature of the operation of extirpation. It is an easy matter to *devitalize* a pulp, but to *extirpate* it is another and wholly different operation. If an operator allows himself simply to devitalize, and not remove wholly the debris from the root canals, he may surely expect trouble in the root membrane. Delicate and difficult as this operation is, in the flattened roots, time and patience in the use of the requisite means will accomplish it, and leave the peridental membrane unharmed. This being the case, we may expect a long continuance of a pulpless tooth in the mouth.

Here we are confronted with the objection that, after the death of the pulp, the root membrane being compelled to perform vicariously the function of the pulp, induces hyperæmia, and at length its own destruction. This objection is a *petitio principii.* It assumes, without proof, the main point at issue. In premise and conclusion it is false to fact. Vicarious performance of function is in this case anatomically impossible; and as I have shown, I think, in this essay, it is not physiologically required.

If the peridentium is left unharmed by the death of the pulp, the performance of its own legitimate functions is alone adequate to sustain the tooth structure in all its oral relations. The hard tissue having gained a sufficient degree of density and hardness to maintain that structure by a law of mineralization independent of the vital functions of the pulp, will certainly, on the death of the pulp, make no unusual demand on the peridentium for vital support. It no doubt does give its measure of support to the dentine of the roots, and also to the dentine of the whole tooth, so long as the nerve plexus remains intact throughout the whole structure. Performing thus *its own* legitimate functions, it is enough.

In concluding this essay it seems necessary to guard against misapprehension, thoughtless antagonism of ideas, and unwarrantable conclusions; for some gentleman *may* rise and say, "If the teaching of this paper be correct, I see no need of the dental pulp; we may as well extirpate the pulps of all teeth at once, and save mankind from all contingencies of dentalgia and loss of the teeth." A foolish objection, indeed! I will, however, accept its rational aspect so far as to say that the contingencies alluded to are neither sequences nor consequences of *healthy* pulps in *sound teeth.* For a similar reason ignorant operators have removed sound and healthy teeth of the first set to encourage the development of the second set. Let nature alone to eradicate temporary teeth, and to obliterate pulps in her own time and in her own way. The practical bearing of this paper regards only the treatment of *diseased and dying pulps.*

Another may say, "If teeth arrive at maturity in density and hardness in any specified number of years, when it may be said that the pulp is of no further use, I see no reason why we should not abandon pulp treatment altogether, and extirpate every exposed pulp."

This objection rests on a misapprehension and a misstatement of the teaching of this paper. The conclusion drawn from the decreasing size, decreasing functional power and decreasing resources of the pulp was that the tooth structure arrives at a period of development fully adequate for every performance of function before middle life, and that therefore the pulp *is of little importance* in the economy of nature, compared with its importance in earlier life. I do not say of *no* importance. In any case of exposure, with little or no disease of the pulp, it is worth while to attempt to save *this little* of pulp function whenever it can be done with the reasonable degree of certainty to which good operators have attained. But that there *is* a period when the hard structure has arrived at such a degree of maturity, that, in a case of disease, the *comparative value* of the pulp is to be considered, and with the chances of final restoration to healthy function are also to be considered *well* the natural tendencies to obliteration, and the consequent feeble hold the pulp has on life; and the question of *abandoning* treatment, pertains *only* to the class of badly diseased pulps—abandoning it for reasons which have, with some fullness, been presented in this paper.

Another will say, "I prefer to give the treatment, *in every case*, and take the chances; if death of the pulp and abscess, let it come. I will then cure the abscess." In the prognosis of a diseased and dying pulp, something else is more worthy to be considered than simple abscess. Abscess induced by a slow ebbing out of the life, and slow wasting of the substance of the pulp, is not of the benign character of an eight-days' abscess, although the latter may inflame and swell with ten-fold more pain and discomfort to the patient than the former. It is the chronically congested condition of the root membrane that attends a slowly-forming abscess, and that so often remains *without cure*, after the abscess itself is cured, that should excite the alarm of every operator who will *willingly* run the risk of abscess, in the confidence he has in an easy cure.

The preservation of the teeth in their entirety is conservative dentistry. But when, by inevitable disease, the vitality or functions of two or more kinds of tissues are endangered, it is the part of wisdom to sacrifice that which is of least importance, rather than that which is of greater importance.

The whole thought of this paper has a basis in the comparative value of the pulp at different periods in life, which I have attempted to establish as a physiological fact. Its tendency to gradual obliteration, and its ready death from very slight causes—as from the presence of a small filling in a cavity, that has penetrated not more than half through the dentine—have been brought to your notice to show with what feeble tenacity the pulp holds its vitality, and to show its very limited susceptibility to treatment when diseased. Any modification of practice which may grow out of the view of the subject here presented should be based more upon the greater probabilities of the continuance of the teeth in the mouth till old age, by the careful and skillful extirpation of an emasculated pulp, than upon any treatment popularly resorted to for its preservation.

DISCUSSION.

Dr. Safford G. Perry (*New York*): It appears to me that practice founded upon the conclusions of Dr. Ingersoll's paper will generally be sound. For years back I have not undertaken to assume that so long as a pulp gave no trouble all was well. In all cases in which I have capped pulps, the operation has been only a tentative one. In no case, for a number of years, have I permanently at once filled a tooth the pulp of which was actually exposed. I have practiced filling such teeth, after capping, with amalgam, which might be easily removed should the pulp die; and have instructed the patient to immediately report at the first symptom of pulp trouble, in order to avoid risk of injury to the root membrane. It seems to me this membrane should be especially well guarded, for the usefulness of the tooth depends more upon its integrity and well-being than upon anything else.

Another point seems to me of much consequence—the age at which teeth may safely be devitalized. In teeth in which consolidation has fully taken place, devitalization will do less harm than if the tooth is not in such condition; while with unconsolidated teeth—young teeth—the palliative, conservative treatment should be adopted. I have not yet reached the point of capping after a portion of the pulp tissue has been devitalized. I know it can be done successfully, for I have seen several such cases; as, a live pulp in one root, and abscesses on the other roots. Cases of such persistent pulp vitality are not uncommon; and perhaps it may prove that we can preserve life in almost any condition of the pulp except where death has already occurred. But is it necessary to do so? We know that a safe and serviceable tooth may be obtained by devitalization and proper root filling. I don't like to take risks with my patients. With a capped pulp it seems to me there is always danger; while all the gray-haired men present will support me in saying that a devitalized tooth, well filled, is as safe as any tooth can be made. I am happy to be able to say that, especially in the last few years, such a thing as having a capped pulp coming back to me with an abscess is almost unknown. Perhaps because I cap only favorable cases. The procedure can be made almost as certain as any in the range of our operations. If a tooth has been capped, and, after a year or two, deposition of secondary dentine has occurred, that tooth may then be filled permanently, with almost a certainty of as permanent success. Two years ago I treated an upper molar, in which there was a small exposure. I made a careful record of the circumstances at the time, and then introduced, first, creosote and oxide of zinc, and then oxychloride, finishing with gutta-percha. Recently I removed this filling because the gutta-percha had worn, and allowed food to remain lodged near the gum; and also to ascertain the condition of the pulp. I found everything exactly as it was when the operation was performed. There was the same extent and character of exposure, in the same place. I again filled the cavity, proceeding exactly as before, except that I substituted amalgam for gutta-percha, in order to restore the contour of the tooth. This operation I completed at one sitting. I do not regard the amalgam in this case as a permanent filling. I shall test the tooth with ice every year, and if I perceive a loss of vitality I will remove the amalgam. I hope, however, to be enabled, some day, to put in a gold filling in that tooth, over a live and healthy pulp.

Dr. E. A. Bogue: Last week I removed a temporary gutta-percha filling, under which was an oxychloride cap, the whole having been put in by me about two years ago. The condition of the pulp was much as Dr.

Perry describes, there being the same extent and manner of exposure as when the cap was put on. I have long been of the opinion that when the odontoblasts of the peripheral portion of the pulp are destroyed, through amputation or ulceration, a deposit of secondary dentine does not occur. This is, to me, practically the same as saying that when the exposure is large, or of long duration, I have little faith in the probability of the restoration of that pulp to a healthy condition under a cap. I do not say that such a thing cannot be done; but, to me, the risk to the tooth in such cases is greater than if the pulp is destroyed and removed. I believe that the function of the pulp in adult life is, mainly, deposition of secondary dentine behind an orifice of decay, after the manner best described by Hume. In such part of Dr. Ingersoll's paper as I have heard, he does not refer to this point. His theory is both proved and disproved by the instances he adduces in its support. For example, he speaks of hard, dense teeth, in which the fibrils have nearly disappeared, as being less liable to decay than loose-structured teeth in which fibrils are plenty and sensibility exalted. I do not suppose that either the presence or absence of the pulp has much to do with decay of these teeth. On the other hand. I think all surgical analogy that, in careful amputation of any non-vital organ, the parts are much more liable to heal and remain sound when anything extraneous to them is not left behind to become decomposed. I wish to be able to supply such conditions to the tooth as will the most surely result in its restoration to health and usefulness; and I believe that, in many cases, the shortest and best method, for both patient and operator, is devitalization and entire removal of the pulp.

DR. J. MORGAN HOWE (*New York*): In a paper which I read before this Society somewhat more than a year ago, I expressed the opinion that when any considerable portion of the peripheral odontoblast cells of the pulp have been removed, there is little possibility of any deposition of secondary dentine in that quarter. I am glad to hear my conclusions endorsed to-night. I think there are many things in the paper we have just heard which should lead us to take a broad view of this subject. We all recognize the value of a live pulp in a healthy tooth; but it seems to me that consideration for the pulps should not lead us to neglect consideration for the patient. To save pulps is very good; but it is better, I think, to save teeth, with the least possible pain and trouble to the patient. We should not drift into a stereotyped practice, but should treat each case according to its own attendant circumstances. About two years ago a young girl, sixteen years of age, came to me with an exposed pulp in an upper cuspid. Although the pain was severe I was greatly disinclined to destroy the pulp. I endeavored to stop the inflammation, but with little success. For three days the patient begged me to destroy the pulp, but I refused; and finally the pain ceased. I covered the exposure with oxide of zinc and creosote, followed by a little oxychloride, finishing the cavity with gutta-percha. About six months ago I removed the filling and examined the cavity. The dentine was sensitive, and I was satisfied that I had saved the tooth. About two weeks ago I again examined the tooth, and found it healthy and of normal color. The course pursued was successful with that tooth and patient; but I do not think I should have been justified in acting the same way with a tooth farther back in the mouth, or with an older patient.

Dr. A. C. Hawes (*New York*): I believe that the majority of exposed pulps, if treated to save them, die within two years, in spite of treatment. The pulp gets, as it were, a deadly blow by exposure, which will eventually cause its death. I lately remarked what I believed to be true, that there will surely be a reaction in this matter of wholesale attempts to keep exposed pulps alive. I do not quite understand whether Dr. Perry approves of the destruction of exposed pulps.

Dr. Perry: I have felt for some time past that Dr. Howe was right in his conclusions as to the impossibility of closing the breach over an exposed pulp when the odontoblasts have been destroyed. Therefore, with an elderly patient, I should probably destroy and thoroughly extirpate a largely exposed and badly inflamed pulp. I should then feel, after the root was well filled, that I had pursued the course best calculated to retain that tooth for future usefulness. I do not like to relinquish such a reasonable certainty for the chances of failure sure to be incurred by attempting to save such a pulp. However, with a young patient I should expect many more chances of success through capping than with an older one.

Dr. Benj. Lord: Will Dr. Howe detail his method of treatment of the case he has just narrated?

Dr. Howe: Tincture of aconite root and creosote, half and half, and an application of iodine. I hardly think the iodine had much effect.

Dr. C. D. Cook (*Brooklyn*): What creosote?

Dr. Howe: Pure wood creosote. I have had some creosote since then, about the value of which I have doubts, since it does not readily attack living tissue. I prefer wood creosote to carbolic acid.

Dr. Cook: As I understand it, wood creosote does not produce an eschar on living tissue.

Dr. Howe: I did not expect an eschar, but looked to see the soft tissue whitened when touched by the creosote. As to Dr. Hawes' implied criticism of my course, I feel that it is just, and that I should not, under ordinary circumstances, have been justified in doing as I did. But the end was my justification. I would strive very hard for the life of a pulp in a front tooth of a young patient; but under other circumstances I would be apt to quickly apply arsenic.

Dr. Bogue: I have in mind three instances in my own practice, occurring very lately, where deposits of secondary dentine had so engorged the chamber, that I had the greatest difficulty in entering the pulp canal. The chance of such deposit appears to me to form the most prominent reason for preserving pulps.

Dr. Cook: In Dr. Hawes' remarks I noticed more matter of "belief" than statement of fact. Now we have all found our "beliefs" to come to naught, especially as to the treatment of dental pulps. Six months ago my faith was similar to that of Dr. Hawes. I did not believe so many pulps were saved as were so reported. I had followed the Atkinsonian method from its first promulgation. About six months ago, having heard that oxide of zinc and creosote, covered with oxychloride, would be of benefit for exposed pulps, I took that "new departure," and, to me, it has proved of value. In a number of cases, where the person has not been suffering from pain, I have not hesitated to fill the tooth after such treatment, and have not had one such case return to me with pain as yet.

Dr. Perry: Have you done this in cases of large exposure?

Dr. Cook: I have not made a record, and speak from recollection alone. Still, I know my patients have not returned to me. They may have gone elsewhere. I do not know as to that. I think we sometimes lose sight of that point in our statements of cases. Some one else may have been the executioner of those pulps. Belief in the matter of research is of little value. Facts are what are needed. A careful record of all operations in this direction would be of immense value to us. I do not say that the method I am pursuing is the only worthy method. A system of records would doubtless introduce to us other ways of perhaps even greater value.

Dr. Hawes: My belief in this matter is founded on long experience and careful observation. I know that pulps die, upon which I have expended my best efforts, and used to the full the most approved modern saving doctrines. I have the least trouble in cases in which I destroy the pulp promptly—under the proper conditions, of course.

Dr. Cook: At what age does Dr. Perry call a person "elderly"?

Dr. Perry: I know no exact rule, but I suppose forty is older than ten. I should treat a person of forty differently from one of ten. I know no better way of arriving at an answer to that question than by keeping a careful record of all cases, and, from time to time, comparing results with circumstances.

Dr. Cook: In case of fracture of any bone in a healthy person, would you expect to cure as readily at forty years of age as at eighteen?

Dr. Perry: The reason why I should be more ready to devitalize at forty than at ten is, that at forty I have a solid, completely calcified tooth on which to work; while the porosity of the child's tooth would much decrease the chances of success.

DR. W. T. LAROCHE (*New York*): I have been able to save more teeth by capping, using creosote, gutta-percha and tin, than by any other way. I am careful not to touch the pulp if I can prevent it. I put in creosote and oil of cloves, allowing the application to remain about a minute, and then dry very carefully with a small piece of paper. I then take a small piece of very soft gutta-percha, and with a properly shaped instrument stick it to one side of the cavity and draw it across, over the exposure, to the other side, thus forming a cap. This cannot be done with White's or Johnston's gutta-percha. I then cool it with an air syringe, and lay a piece of tin foil over it, finishing with gold. Of course the gold is very close to the pulp, but it does not touch it. I have a number of cases so treated, now three or four years old, and in which I have actually seen the pulp, which are doing well. Of course I cannot tell how long they will remain so; but the operation is, so far at least, successful.

Adjourned.

REGULAR MEETING, MAY 21ST, 1878.

The meeting was called to order at 8 o'clock, P.M., the President in the chair.

The Society received from Dr. H. H. Winn, of Shanghai, China, an entire artificial denture, of native Japanese manufacture, for which the thanks of the Society were voted.

"Incidents of practice" being called--

DR. WM. JARVIE, JR. (*Brooklyn*): At a meeting of this Society, held a year or more ago, I related an instance of replantation. To-night I have the sequel. That you may all understand the incidents connected with it, I will briefly recall them. In 1863 or '64, while a portion of the Union army were encamped on Morris Island, the Major of a New York regiment suffered severely with toothache. The tooth, an upper second bicuspid, was extracted during the afternoon and thrown out in the dirt. Late the same evening it was discovered that the wrong tooth had been removed, the offending member remaining in the mouth. This was finally extracted, the sound tooth found, and an endeavor made to force it back into its own socket. The attempt was not successful, examination showing that the surgeon had half rotated the tooth, or placed the buccal cusp where the palatine ought to be. A second attempt was more successful, and the tooth grew quite firm in the socket. In 1873 an abscess formed at the end of the root, which succumbed to treatment, and I then filled the pulp canal, which had not been done previously. I have seen the tooth from time to time since 1866, and with the exception of the abscess just mentioned, it has been perfectly comfortable during the whole time. A month ago the gentleman came to see me, saying that the crown of the bicuspid had broken off a few months previous, and the root was giving him considerable pain. I extracted the root, and fitting the crown upon it, discovered the condition of things which you see (tooth shown). The wire along the side is simply to keep the crown and root in their relative positions.

Absorption has progressed to such an extent as to almost girdle the tooth, commencing at the enamel and extending from one-third to one-half the length of the root, leaving the upper half of the root intact. Fifteen months ago a similar case of absorption occurred in my practice—the pulp in that tooth being alive, however; but the absorption commenced just above the line of enamel and extended two-thirds the length of the root, the upper third being smooth and perfect. The direct cause of the loss of substance I attribute to the presence and action of giant cells or osteo-clasts, the same process as takes place in the absorption of the roots of the temporary teeth; but I hope to get some light this evening as to the cause of their *presence* and *activity* in cases of this kind.

We have all known cases where absorption has commenced at the end of the root, of which it has removed a large portion ; but these are the only cases I have seen where absorption has begun at the neck of the tooth. I cannot understand why this action should occur here, the root being free from tartar, and no apparent cause of irritation being present.

DR. A. H. BROCKWAY (*Brooklyn*) : I have seen one or two cases in which absorption was general throughout the root, giving a markedly honey-combed appearance.

DR. PERRY : I have seen cases where semi-tubular canals formed around the root, like the markings in worm-eaten wood.

DR. JARVIE : The remaining teeth were all sound. I think this is the only tooth the gentleman has lost. I believe this peculiar absorption to have been due to the action of the odontoblasts, which are believed by histologists to secrete an acid fluid which dissolves the substance of tooth or bone. This loss of substance is different from that found in decay of the teeth ; for, in absorption, both the organic and inorganic matter are removed, while decay attacks mainly the inorganic salts. An interesting item in the history of this tooth is that it was replanted some fourteen years ago, and remained in the mouth until three weeks since.

The Secretary then read the following paper :

THE TUBULI AND THEIR TENANTS.

BY JUNIUS E. CRAVENS, D.D.S., INDIANAPOLIS, INDIANA.

" The dental pulp is that soft, fleshy mass occupying a central position in a tooth ;" it is the remaining portion of the papilla in which the tooth had its origin, and the diminution of which is accomplished by the deposition of calcific material between and about the filaments of the odontoblasts. * * * * The pulp possesses a communication with the general organism, by virtue of a foramen at the apex of each root of the tooth, through which a portion of the pulp passes like a small cord, composed of a minute artery and vein and nerve, embraced as a whole by connective tissue, so that the apicial foramen may be termed the dental umbilicus, and the slender extension of the pulp the umbilical cord of the tooth.

FIBRILS (!)

It is generally conceded by histologists that there are nerve filaments given off by the dental pulp, and that these penetrate the tubuli of the surrounding dentine. The sensitiveness of dentine certainly indicates such an arrangement, but amongst those who so believe are some who claim that the nerve filaments occupy but a portion of the length of the tubules, whilst others advance the opinion that the tubes are thus occupied throughout their limits.

On the other hand there are some very eminent dental pathologists who dissent from the theory of any filamentine nervous occupancy whatsoever of the tubuli. In regard to these differences of opinion entertained by various distinguished dental writers, it is but justice to the minority, respectable alike in number and accomplishments, to state that the actual presence of nerve fibrils in dentine tubuli has not been so clearly demonstrated as to remove all doubts from the minds of those who previously believed they had good reasons for their skepticism.

No recent writers deny, so far as I am aware, the fact that the dental pulp is covered by myriads of filaments directed toward the tubuli, or that they are inserted into the mouths of the tubes.

These filamentous processes are the *soft fibres of Tomes*, and whilst their existence cannot be denied, they have not, thus far, been traced beyond the mere orifices of the tubuli, except in a few anomalous cases, wherein the tubes involved were hypertrophied or greatly enlarged, and even these instances are involved in doubt. The further ramification has good theoretical support, based upon an assumed necessity, but is certainly a matter of much speculation.

The extreme sensitiveness of dentine is the principal argument in favor of a *necessity* for intra-tubular nerve filaments, although undeveloped under the microscope.

The second argument of importance, favoring filamentine nerve occupation of dentine tubules, is the fact that originally there were odontoblastic filaments occupying the exact sites of the tubuli, indeed were the bona-fide predecessors of the tubes.

But then, even after admitting the above arguments to be based on facts, they lack real force as evidence, because it has not even been claimed that the minute hair-like prolongations of the odontoblasts are nerve filaments.

In the promotion of the minute tubular formations, nature employs the odontoblastic filaments as mandrels, which is a peculiarly mechanical use of them. The dentine hardens or is formed from the periphera, as calcification advances inward, and the intertubular substance with the tubules completes a perfect barrier all about the enclosed papilla, except on the side from which the root is projected.

The calcification of dentine is a part of the phenomena of assimilative development that is characteristic of organization in action. As such action is destructive as well as formative, there is resultant debris, which must be carried away by the capillaries of the pulp, inasmuch as the wall of dentine precludes any such action from the external aspect, at least within the enamel, and also throughout the length of the root, previous to the development of the cementum; and after that there is barely enough of such transfer through the bone arrangement of cementum to support the stability of that structure, and contributing nothing appreciable to the nourishment of dentine proper. Remember that dentinal calcification begins externally. It is, therefore, necessary that the refuse and broken-down matter, resulting from developmental action and tissual support, should be conveyed to the intra-dental circulation, and this can only be, and *is* accomplished by the tubules themselves; perforce osmotic, or capillary, or both.

In the lungs it is known that there is tidal air penetrating the remotest subdivisions of bronchi; that which passes out conforming to the walls of the tubes, and, being hollow, admits a solid column of air of ingress through the tubular air of egress. If there are counter currents of air in the minute air passages of the lungs, why may there not be counter currents of fluid or semi-fluid throughout the length of dentine tubules? It is true there are no fine ciliary oscillators lining the dentine tubule to compel a current, as in the bronchi; but then the bronchi are hollow and unoccupied by matter, whilst the dentine tubuli are tenanted by semi-solid organic matter, so that in the latter case cilii would be not only impracticable, but unnecessary, as I hope to show.

The organized contents of the tubuli, and the minuteness of calibre of the tubes, combine to form a structure that, to become suitable for osmotic action, would only require to be placed so that the extremities of the tubes would be bathed, or in contact with two fluids, one at either end of each tube; the one fluid being charged with some proper substance, the other being uncharged; or the two extreme fluids being differently charged, but with substances that were interchangeable; or the tubes being occupied their entire length by one fluid, which is supplied with pabulum at the inner extremity, and the debris of destructive assimilation at the outer or looped terminus.

The soft fibres, or filaments, given off by the pulp, are insinuated into the entrances of the tubes, and do, indeed, pass through their entire length; but are these filaments nerves? I think not. Originally they were nothing more than *homogeneous fibres*—blastemic elements, neither distinctive tissue nor perfect fluid. These *homogeneous* fibres were designed in the admirable economy of the Creator to perform the double function of conveying sensation and transmitting fluids, because the tubules of dentine were too small to admit within them a complex arrangement of nerve fibres and blood capillaries. The odontoblastic filaments were, in the beginning, simple homogeneous elements, around which calcification could take place, and thus accomplish the formation of the tubuli; but the tubes once formed, the mechanical purpose of the filaments was done, thenceforth their function was the double one of conveying sensation and transmitting fluid for the preservation of dental tissue. There is no evidence whatever of any change in these filaments from homogeneous to nerve structure, and it would be quite easy for the microscopist, finding these blastemic elements of filamental form, to mistake them for nerve fibrils that have been so longed and sought for in dentine tubuli.

The Secretary next read the following paper:

ON THE CLEAVAGE OF ENAMEL IN THE PREPARATION OF CAVITIES.

BY J. EDW. LINE, D.D.S., ROCHESTER, N. Y.

The operation of filling teeth, whether with gold, tin or other material, necessarily involves two steps—the preparation of the cavity and the introduction of the filling. Both these steps are important, and the successful termination of the second is largely dependent upon the correct performance of the first. That a tooth may be well filled, it is certain that the cavity must be properly prepared; that such preparation may be possible, the cavity must be accessible; and, when prepared, the walls should have sufficient strength to resist the forces exerted in the operation of filling, as well as in mastication, and to prevent the consequences so apt to follow or attend the misuse of instruments for the removal of food from between the teeth.

As you know, the margins, or edges, of the walls of cavities consist, in some cases, of enamel, dentine, and cementum; and in others, of enamel alone. The last statement is more especially true of cavities which open upon the grinding, buccal and lingual surfaces of molars and bicuspids; and upon the labial, lingual, and (in the majority of cases) mesial and distal surfaces of incisors and canines. Cavities which open upon the mesial and distal surfaces of bicuspids and molars may, and in some cases do, possess wall having margins of enamel; but generally more or less of the enamel of these surfaces is removed by the chisel, disk or file, the cavity opened from the grinding surface, and the filling trimmed flush with the cut side of the tooth. In cavities thus prepared—a style quite common with the opponents of "contour" filling—enamel margins are always found at the grinding surface, occasionally at the sides towards the tongue and cheek, never at the neck.

You all have examined teeth which have been filled for years, and have been, perhaps, surprised at certain peculiarities exhibited by the tooth in close proximity to the margins of the filling. These are, color and structure; the first varying from very slight difference with that of the tooth to brown or black; the second ranging from a mere defective line to a coarse, ragged border. In many such cases the conclusion may have been jumped at that the operation was originally a poor one, and the operator a bungler. Such a conclusion must be pronounced, to say the least, hasty and unjust; for the filling may have really been one of the best, and the operator almost without a peer; and yet, simply because a thing, very slight in *apparent* importance, had been overlooked, the operation now does him very little credit, and has not contributed very greatly to the salvation of the tooth. It is this seemingly little thing to which it is the object of this paper to draw attention.

In all well-formed and well-filled cavities which open upon the grinding surfaces of molars and bicuspids, and the outline of which is considerably within the axes of the cusps, the more or less discolored and defective line before spoken of is rarely seen; but it is much more common in cases where the cavity-outline encroaches upon the summits of the cusps or passes beyond them.

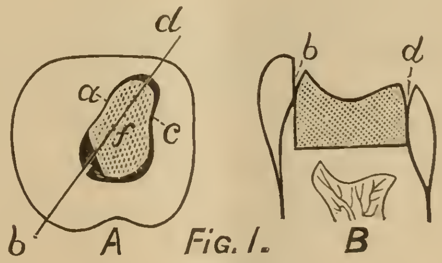


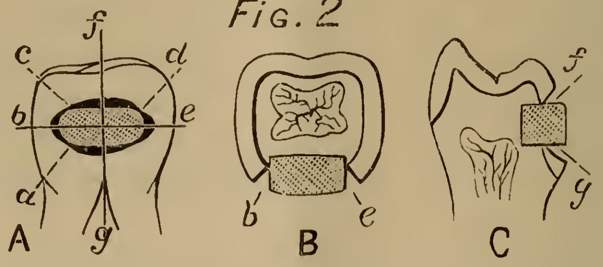
FIG. 1.

A, Fig. 1, is a diagrammatic representation of the grinding surface of a molar, containing the filling, *f*; at *a* is seen a mere line of discoloration at the margin of the filling; at *b*, *c*, and *d*, this line is much darker and broader, and the tooth-substance here seems broken or disintegrated. At *b* the edge of the filling is at, and at *d* is beyond, the axes of the cusps, and the amount of discoloration and disintegration is, as seen, proportional to the distances of these points from the centre of the crown.

This figure illustrates the facts to which I made allusion before, that as the outline of such a cavity approaches the vertical axes of the cusps, the conditions favorable to the formation of this defective line are increased; and that when the summits of the cusps are passed the color is deepest in tint, and the enamel breakage at its worst.

B, Figure 1, is a vertical section through the line *b*, *d*. Here the filling is seen to possess edges cleanly cut and well defined, while the margin of the cavity is broken away, in a definite and uniform direction, *that of the enamel rods.* The breakage at *b* is less than at *d*, because the peculiar inward curve described by the enamel rods in this part of a cusp here approximates the line of the cavity wall; while at *d* the breakage is greatest because here the enamel rods, being upon the outward side of the cusp, trend away from the filling. Any slight undercut, particularly if near the surface, will intensify this condition.

Fig. 2



In cavities which open upon other than the grinding surfaces of molars and bicuspids and the lingual surfaces of incisors and canines, this defective line is found on three sides—right, left, and next the grinding surface or cutting edge. It is also found on that side next the gum, in teeth the enamel of which retreats or curves suddenly toward the roots. A, Figure 2, represents a molar having a filled cavity on its buccal surface. Beginning at *a*, and following the edge of the filling upward, we find a considerable defect to exist at *b*—the point nearest the angle formed by the buccal and distal surfaces of the tooth. From *b* to the side toward the grinding surface the defectiveness grows less (*c*); but immediately increases, when that side is reached, to proportions which it maintains until the opposite side corresponding to *c* is attained (at *d*), where it again decreases, widening again, however, at *e*, the point corresponding to *b*. B, Figure 2, is a horizontal section through the line *b*, *e*, and shows the breakage of the enamel at these points. In cases of sudden curvature or retreat of the rods toward the root, the line of breakage is shown at *g* in C, Figure 2, and that toward the grinding surface at *f*.

In cavities of the mesial and distal sides of incisors and canines, the defect under consideration is quite as remarkable as in the cases just noted. A cavity in either of these places may have the appearance shown in

A, Figure 3, where *a* represents the defective portion, the greatest amount of breakage being on the side toward the cutting edge of the tooth, and being increased by any undercut. A vertical section is seen in B, of the same figure.

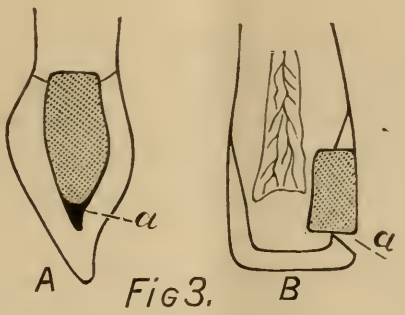


Fig 3.

The circumstances which make possible such defects as shown may be found in the direction of cleavage of the enamel and the form of the cavity. Whether the splitting line of enamel is between the rods, or through their centres, is not essential to the present aspect of the subject. It is certain that the line of cleavage follows the direction of the rods. In a well-formed molar this direction may be generally formulated as being in right lines, diverging from a point in the pulp-cavity between the neck of the tooth and the apex of the root, and quite near the neck. In suddenly retreating crowns, as in bell-shaped teeth, the rule is that this point of divergence (at least for that portion of the enamel nearest the neck of the tooth) is between the neck and the grinding surface or cutting edge. In cusps and their modifications the direction of the rods is peculiar, and has a practical bearing of some value.

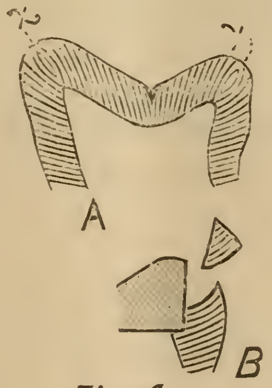


Fig. 4.

At *b*, in Fig. 1, the cleavage is within the summit of the cusp, while at *d* (same figure) it is beyond. The fracture at *b* is due, primarily, to the peculiar curve described by the enamel rods of the cusp, which do not radiate from a centre common to those rods otherwise situated, as is usually represented, but curve upon each other, the outer upon the inner, as shown in A, Figure 4, at x, x. It will be easily seen that the liability to fracture is greatly increased when the cavity is undercut; but, whether undercut or not, the summit of a cusp cannot be approached from the centre of the crown without more or less risk being incurred. When the summit of the cusp is passed, no undercut is needed to ensure fracture or cleavage of the enamel; for it will then occur in despite of every precaution (other than proper preparation of the cavity with regard to the cleavage line), should this particular part be worked upon by the plugger, or come in contact with an opposing tooth or other hard substance.

The form of cavity which contributes most to the failure of fillings is that the walls of which are at a right angle with or perpendicular to the surface of the tooth, or more or less undercut, either in the substance of the enamel or beneath it in situations where that structure is very thin, as at the necks of teeth. If undercuts are properly placed, *beneath* the enamel and *in* the dentine, and the edges or margins properly shaped, there need be little fear of enamel fracture at the edges of the fillings, in teeth of reasonable strength.

As one of the secondary circumstances which lead to the formation of the discolored and defective line before noted, may be named the operation of inserting the filling. The impact of hard cylinders of gold may, in cervical walls, dislodge particles of enamel, but this defect is much more likely to attend or follow the use of cohesive foil, when that form of gold is placed in the cavity in small pieces and sent "home" by the hand (or automatic) mallet. Where the mallet is not used, it is replaced by hand pressure, and the rolling and rocking of the instrument, with its occasional misplacement at the edges of the cavity, tend to detach variously-sized masses of enamel-rods at such points. (See Fig. 4, B.) This roughening of the margins of a cavity may account for the readiness with which acid secretions take hold on the tissue at such points, as also for that appearance of secondary decay which, too often, soon follows filling. The sides of cavities next the buccal, palatal, labial and lingual surfaces, as well as more distant parts, are quite as likely to be broken by the plugger point.

The same results follow (if they have not occurred before) after the gold has been introduced and while its condensing is in process, whether the hand or mallet be used. Much force is usually expended in this part of the operation, with the result of a rough and ragged margin.

Another secondary cause of enamel breakage is the use of the burnisher to produce a bright, hard finish. Hard burnishing will thoroughly pulverize the margins of badly formed cavities, and thus leave a groove encircling the filling, which needs only time to ensure discoloration.

The use of rottenstone on moistened tape will clearly reveal any defect around the filling, at once after it has been inserted, and may cause the operator to wonder "how it happened that he failed to pack his gold close to the margins of the cavity," the truth being that he had simply destroyed those margins during either the introduction or finishing of the filling.

Mastication, as has been already said, is also an agent in producing marginal cleavage of enamel. This force is peculiarly hurtful where gold, amalgam, or Wood's metal fillings are used. Tin is the only metallic filling around which the line of discoloration does not often occur. This is because the metal is so soft and readily compressed and moulded into defective places by the occluding tooth, that the space left by any enamel cleavage (which undoubtedly happens with tin as with other fillings) is quickly filled up.

After the filling has left the care of the operator, there remains still another mechanical agent the works of which are evil—the tooth-pick. The margins of cavities in friable teeth are readily broken away by a very stiff quill pick, and those in the strongest teeth cannot withstand metal picks. The amount of fracture in these cases is certainly slight, but it is quite sufficient to allow secondary decay an excellent chance for its beginnings.

And now a word about that form of cavity which, in the judgment of the writer, is best calculated to preserve its own integrity, to prevent secondary decay, and to maintain the comfort and usefulness of the tooth.

If the (perhaps too many) words already used by the writer, have any evident moral, it is, that the walls of any cavity, in any tooth, and in any surface of that tooth, should be cut in the line of cleavage of the enamel. Where the enamel is thin it is not safe to undercut, except in the dentine. Where it is thick the walls may safely be cut out of the line of cleavage.

To sum up—bevel the walls of the cavity in the line of cleavage of the enamel, and, if possible, to the full thickness of that tissue.

DISCUSSION.

Dr. J. W. Clowes (*New York*) : When I am filling a tooth I have only one object in view, to save it ; and when I have excavated the cavity properly, and have filled it properly, I have accomplished my object, without considering this matter of cleavage at all. If such things occupied my mind and attention, I would be very slow over my work. This matter may be very important ; but, so far, I have not considered it, knowingly, during an operation.

There has lately been much said upon the character of gold as a filing material. We have been told that it is incompatible with tooth-bone, and even that it makes a very good temporary filling. As far as regards myself, I should like to be known as saying that gold never fails in the mouth when properly used under proper circumstances. The thousands of gold failures are caused by defective manipulation, not by the faults of the material. I have been called a believer in amalgam. I am a believer in amalgam; but that fact does not lessen my belief in gold. I believe also in tin, and in any other material which will accomplish the effects we desire. I repeat that failures with gold are not the fault of the material, but of the men who use it so that it fails.

DR. BROCKWAY (*Brooklyn*): I shall have to differ from Dr. Clowes in his estimate of the value of the suggestions we have just heard read. As it strikes me, the paper is very interesting and valuable. I have recognized in my own practice the conditions referred to by the writer, and have, without special thought of the matter, conformed to them; but I have failed to realize, so fully and clearly as now, their importance. I feel under obligations to Dr. Line for his full and clear presentation of this subject.

DR. SAFFORD G. PERRY (*New York*): This is a matter of much interest to me. For years I have followed the plan of having sound enamel margins before introducing the filling, no matter what the material. We know how an originally small cavity will often become a tolerably large one through the cutting to get at sound structure. I have conformed to the enamel cleavage line a long time, perhaps partly unconsciously. I begin by breaking down the enamel on every side of a cavity, with instruments suitably formed and tempered. To secure a perfect margin, I use instruments specially formed and tempered, not only to cut the enamel, but to assist my sense of touch. I grant the accuracy, in general working, of the engine, but do not believe in it for this portion of an excavation. To me the *feel* of the hand instrument is a very valuable guide for cutting margins. If there is a soft place I am certain to find it. The engine will not allow this accuracy to me. With margins so formed, with undercuts as slight as consistent with the safety of the filling (and I wish every tooth could be filled without any undercut), and the material carefully packed, the "dark line" will not come; for this line is due to defective operation, either in excavating or in filling the cavity.

I would like to call attention to a peculiarity of enamel construction in the cusps of teeth. Sometimes, in bicuspids of frail structure, the enamel in the centres—or a little within the centres—of the cusps shows a brownish spot, and seems to dissolve or wash away readily at those points, into cup-shaped cavities. I often have to drill into these points (the centres of ossification), and fill them.

Take a bicuspid with a large proximal cavity extending from the gum nearly to the grinding surface. When this is excavated, the fissure across the crown will probably be encroached upon; and should, in such cases, be cut entirely out. This will leave, in many instances, but a narrow portion of the tooth-substance between the edges of the fissure-cavity and the faulty points in the cusps of which I have spoken. If, under such circumstances, the tooth is filled without enlarging the fissure-cavity so as to include these points, they will continue to enlarge and deepen, and finally cup-shaped cavities in the cusps will be formed on each side of your filling. I think it better to at once include these points in the first excavation. But if much sound tooth-structure lies between these and the fissure-cavity, then I drill these out and fill them separately.

Dr. E. A. Bogue: The paper which we have just heard reminds me how almost all principles, as such, are discovered empirically. I believe I now recognize the fact that, in my most successful operations, I have, almost unconsciously, conformed to the ideas of the paper in regard to the cleavage-line of enamel. Failures enough we have all seen; and many of them will show us the truths contained in this paper and its diagrams. Especially in the use of the mallet and cohesive foil has disregard of the line of enamel cleavage done injury.

Dr. Clowes: Perhaps I too may have been unconsciously in accord with the ideas of Dr. Line. I have always made it a point to cut until sound structure is reached, and to round the edges of the cavity. A right-angled or sharp edge is much more liable to injury, both during the filling operation and subsequently, than a rounded one.

Dr. O. E. Hill (*Brooklyn*): I have heard the ideas of this paper talked about as new. As I understand them, they are old enough. I have heard this matter discussed ever since I began to attend the meetings of dental societies. Another idea seems to lie beneath the surface in this matter—that teeth decay either because of faulty material or of faulty operators. The tooth substance itself, as a factor in the problem, appears to be entirely lost to sight. Of course the filling material and the operator have much to do with the permanency of operations, but the tooth itself has also some claim to consideration in the matter. You may fill some teeth with any known substance and in any known manner, and you cannot save them. I believe the cause of the majority of failures in filling lies in the teeth themselves, and the wonder appears to me to be, not that we save so few teeth, but that we save so many. Gold, tin, amalgam, all are good materials, when introduced carefully and under the proper circumstances; but any one of them, or all of them, will not save all teeth.

Dr. Brockway: It seems to me that Dr. Hill is in error in supposing that any one here believes this idea of enamel cleavage to be a new one. I consider the idea very important, and the operation one which is apt to be overlooked or slighted, but I do not think of it as new. I think, also, that while we have all practically conformed to the teachings of this paper, we may have often done so empirically, and without definite knowledge on the subject.

Dr. Perry: I would like to ask Dr. Atkinson why it is that the enamel often washes away so quickly at the points in the cusps of which I have spoken—the centres of ossification.

Dr. Wm. H. Atkinson (*New York*): If the patient has been sick during the time of calcification, imperfect crystallization will be the result. If such arrest of crystallization occurs, then the enamel will be hard only in the ratio of its effort to get solid. It is a common thing to see brown pits in the teeth of patients who were sick at the time of the formation of the teeth. Yet I have never seen a tooth which wasted in that way unless it was discolored. Its color was certain to be abnormal.

Dr. Perry: I have seen many of these pits. The molars, also, show the same tendency at the tips of the cusps. I have not thought that the teeth so affected were otherwise unhealthy.

Dr. Atkinson: The enamel begins to form over the dentine, where the enamel membrane and the dentinal membrane come together. The enamel grows from the centre to the surface, while the dentine grows toward centre until the tubules are completed and the pulp chamber is formed.

Dr. Perry: Are there any commencements of growth at this point? (*pointing to the cusp of Fig. 4.*)

Dr. Atkinson: No, sir.

Dr. Perry: Why do we have this seam?

Dr. Atkinson: That (*touching cusp of Fig. 4 at the junction of enamel and dentine*) is the point of first calcification of a little lime mud which lays the foundation for the first stellate cell—generally five-sided—that is the base of calcification of every enamel rod. The dentinal cap has to be considerably advanced before there is any enamel. The next step is successive calcification of the cells to the end, at the surface. The rods do approach each other here (*top of the cusp*), but this diagram does not represent the condition correctly.

Dr. Perry: I still maintain that the structure is softer and washes away more readily at the points I have named, and should be cut out.

Dr. Atkinson: I have not found it so.

Dr. N. W. Kingsley (*New York*): I have examined teeth for many years, with the aid of a very powerful lens and delicate exploring instruments, yet I have never seen such cavities in cusps as Dr. Perry describes.

At first I did not subscribe to the doctrine that gold is always the best thing with which to fill teeth. I was under the impression that, in order to use gold successfully, one must have water-tight margins. But about seven years ago a gentleman, known to you all, came to me to have a second molar (I think) filled, the cavity being on the buccal surface, and close to the gum. The patient was in a hurry, going to Europe, with a large amount of business on his hands, short of time, excessively fidgety, and difficult to manage, because all his joints seemed stiff and intractable. I tried to put on the rubber dam ; but between his awkward manner of holding his head and the closeness of the adjoining teeth, I managed to cut the rubber every time. He seemed to be getting restive, and I certainly was, so I resorted to a napkin. Such was the flow of saliva, however, that the cavity was very imperfectly prepared. I managed to remove all the decay, but was doubtful about the ability of the cavity to retain its filling, owing to imperfect shaping. However, I began to insert the gold. About the second pellet or strip (I forget which), occurred a watery invasion. I began again, and again the water came in. In sheer desperation I continued the packing, and got the gold (through the water) into the cavity, and rubbed it down even with the walls. I dared not file it, for fear it would come out, so I told the patient he would have to call again. But he went to Europe without doing so. Afterward, when my brother went to Europe, this gentleman was still there. I had asked my brother to call on the gentleman and get that tooth in order if he could. But the tooth was not touched, and I saw it this morning in the gentleman's mouth. That filling has preserved that tooth perfectly, for more than seven years, in spite of the fact that it is as bad a filling as could be put in. When Dr. Clowes said that success in gold filling depended upon manipulation more than on anything else, I dissented; but I have since changed my mind.

Dr. Wm. Jarvie, Jr. (*Brooklyn*): Perhaps Dr. Kingsley has failed to find the cavities spoken of by Dr. Perry, through not having encountered the teeth in which they were. I have seen such cavities. I have filled one such within a month, in the mouth of a child twelve years old. It was a minute hole, traversing the enamel rods and ending at the dentine. There was no apparent decay—at least what is usually called so—but a softening of the enamel rods, as though calcification at that point had been incomplete. I have had three or four such cases. As to the cleavage of enamel, we are taking cognizance of it every day. I have, as far as I can remember, always considered that matter in preparing a cavity. Referring to the diagram, Figure 2, the writer tells us that dark lines will be found at the margins of the filling after finishing with rotten-stone, and that their cause will be the breaking away of sharp edges of enamel through imperfect preparation of the cavity and faulty manipulation of the filling and instruments. He suggests that defects of this character found in crown fillings may be overcome by the occlusion of the antagonizing tooth. These defects ought not, and would not occur, were the operation carefully and properly conducted, no matter what the filling material might be.

Dr. Clowes: Our friend who put in his submarine filling, "builded better than he knew." A filling of non-adhesive foil may be perfectly applied under water, so long as the water is without admixture of hurtful foreign substances. It may seem singular that I should appear as the special champion of gold; but the fact is, I see so much demoralization going on in the gold ranks, through this new departure into plasticity, that I am afraid the thing is being overdone, and wish to add my weight to turn the scale.

DR. BOGUE: As an addendum to Dr. Kingsley's operation, I have just heard of a farmer who bit a leaden shot into his decayed tooth, and the last time it was examined refilling was not necessary.

DR. GEO. A. MILLS (*Brooklyn*): I had a case similar to Dr. Kingsley's, fourteen years ago, and the tooth is, to-day, as perfect as when first operated upon. Dr. Bogue once said that teeth should be filled with judgment as well as with gold. I think that is an excellent aphorism. There is a class of men who do not give sufficient care to the preparation of cavities. For instance, they do not conform to such principles as are advocated in Dr. Line's paper. Such operations, no matter what the material used, cannot be expected to save the teeth. In preparing all cavities, earnest and conscientious care should be used to make that part of an operation as perfect as any other part. One may learn as much from failure as from success, if he will but consider the matter carefully. I would like to add that I have seen such teeth as Dr. Perry speaks of. I have filled such cavities, and can show the patient.

Adjourned.

REGULAR MEETING, JUNE 18TH, 1878.

The meeting was called to order at 8 o'clock, P. M., Dr. Hawes, Vice-President, in the chair.

The Society received, as a donation from Dr. W. St. George Elliott, the tooth of an Indian elephant, so cut and prepared as to illustrate differences between the teeth of this species and those of the Asiatic animal. The Society, by vote, tendered its thanks to the donor.

"Incidents of Practice" were now called for.

DR. A. L. NORTHROP: A gentleman called upon me, having a molar tooth split entirely through in an antero-posterior direction. The piece was so loose that I could easily have removed it with my finger. The tooth had been filled from the roots. I removed the fillings, and drilled directly through the crown, from side to side, countersinking the ends of the hole. I then made a little gold bolt, with countersunk head and nut; and, coating it with a solution of gutta-percha in chloroform, put it in position, and screwed the nut tight, afterwards filling the emptied cavities with amalgam. I have not yet finished off the ends of the bolt (which will be flush with the tooth-surface), but the result, so far, is very satisfactory.

Dr. Wm. Jarvie, Jr.: A little while ago I renewed an amalgam filling which had given way in a lower molar. Afterward the patient returned with pus discharging from around the tooth. Upon examination, I found the tooth split, antero-posteriorly. There was so much soreness and generally bad condition that I extracted the tooth, and then found that the split extended through the entire length of one root to its apex, and two-thirds the length of the other; which seems to me something unusual.

Dr. S. G. Perry: I remember how, a few years ago, a gentleman came to me with a tooth (perfectly sound and unfilled, but with a dead pulp), which had split longitudinally through the centre. The patient stated that he had heard a sound like a pistol-shot occurring in his mouth. Whether the tooth had split or not at that time I cannot tell; but it is certain that the noise and accompanying sensation caused the gentleman to come to me.

Dr. Brockway: I have here a polishing material, brought to my notice by Dr. Robert Ambler, of Brooklyn, which I find very useful. It is the fibre of the tucum tree. It appears to be highly charged with silex, and polishes rapidly, either tooth-substance or fillings, leaving a fine surface. It may be used dry.

Dr. Perry: I would like to mention the success I have had with the soft gutta-percha spoken of by Dr. Laroche at our last meeting. I procured some from him, and used it in the posterior root of a lower first molar, devitalized, and having a large opening in the end of the root, which made it difficult to fill the root to the end while preserving a nice adaptation. I measured the width of the opening with a fine wire bent at right angles. Then, taking a piece of gold wire smaller than the diameter of the hole, I twisted a little loop on one end, and barbed the sides of the remaining straight part, wrapping smoothly around this sufficient of the soft gutta-percha to fill the canal, and thrust the whole into the root, the loop remaining in the chamber, and being covered with ordinary gutta-percha. At any time, if trouble occurs, upon the removal of the crown filling, an instrument thrust through the loop of wire may lift the root filling from its place. The filling fits so well that I think there is no danger to be apprehended from leakage. The ordinary gutta-percha would not serve in such a case and method.

Dr. Laroche: I have given samples of this gutta-percha to both Messrs. White and Johnston, the dental manufacturers, requesting them to make some for the general profession. Two and a half years ago I filled a tooth which I to-day refilled. The tooth had formerly been filled and refilled by another practitioner, and was very sensitive. I took some of the soft gutta-percha, and, sticking it to one side of the floor of the cavity, stretched or drew it across the floor to the other side. On this I laid tin, and finished the cavity with gold. When I removed this filling to-day, I found everything in excellent condition; so much so, that I did not remove the gutta-percha I had first put in. There had been no trouble from the tooth. This gutta-percha is exceedingly soft and sticky when heated, but becomes as hard as the ordinary forms when cold.

The following paper was then read by the editor:

SYSTEMIC ELECTRICITY.

Collated from W. K. Bridgman, L.D.S.,

BY JAMES E. DEXTER.

In the Transactions of the Odontological Society of Great Britain, Vol. 3, old series, 1861–3, and Vol. 2, new series, 1869–70, may be found three papers, by W. Kencely Bridgman, L.D.S., upon various aspects of the electrical activities at work in the human system. The first, read March 3d, 1862, is "On the Absorption of Bone and Dentine;" the second, read June 1st, 1863, is an essay on the "Pathology of Dental Caries," for which the Society awarded to Dr. Bridgman a gold medal. The third, read May 2d, 1870, is "On the Electro-Chemical Action of Metallic Substances Upon the Teeth."

In view of the prominence lately given in this country to the subject of electrical action in the oral cavity, the Executive Committee of this Society considered that it would be well to present to the profession, in condensed form, the principal ideas and conclusions offered in these papers; the more especially since they seem to have excited only slight remark among our English brethren, and since the published transactions of the British Odontological Society are somewhat rare here. The committee, therefore, asked me to prepare such a condensation, which I now have the honor to present for your consideration. Before doing so, however, I will premise that I have rigidly confined myself to the line of reasoning and experiment followed by Dr. Bridgman, although taking the liberty of transposing quotations and ideas from their original arrangement, both as to themselves and as to the papers in which they appear, in order to produce a continuous and coherent story. I have also used Dr. Bridgman's own language, except where alterations were needed for purposes of condensation.

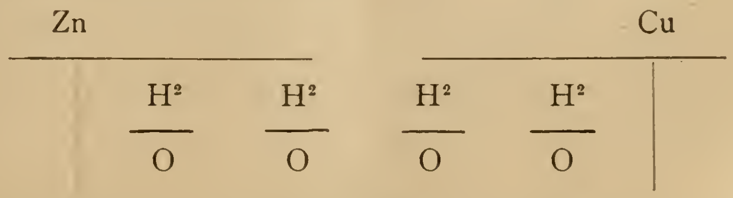
We profess to understand the manner in which fluids are taken up in the system, and to a certain extent we may be right in our suppositions. But in reference to the removal of the more solid substances, such as bone and dentine, there are confessedly many points yet requiring to be explained.

If we stretch out an arm, the contraction of the muscles placing it in the position required is the response to the will. But to enable the act to conform to the will, there must be some other power brought into play to connect the particular muscles required to act with the intended movement. Chemistry may set free the force which accomplishes the motion, but there must be some means of exciting this chemical action in the right muscles and at the proper time. In the recently-dead subject we see this effected by the voltaic current; and as similar currents have been proved to exist in the living subject, we may safely assume a similarity of action to occur here also. Smee connected the muscles in the cheek of a rabbit with a delicate galvanometer, and then gave the animal food. He then says: "The deflection of the needle in the electro-voltaic circuit proved the existence of a voltaic current passing through the parts during the action of biting, and did thus denote the mechanism of the force employed to throw the muscles into operation." Thus there appears to be conclusive evidence that muscular contraction is accompanied by electric currents, which currents in the system will henceforth be spoken of as electro-*vital*, in contradistinction to the electro-*voltaic* currents of the battery, to which they are analogous.

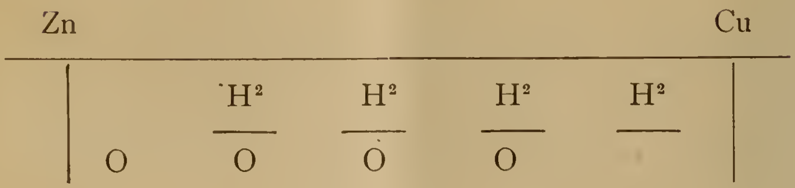
The ordinary action of an electro-voltaic current is, to produce chemical decomposition; and Faraday states that "chemical action is sometimes a more delicate test of electrical currents than the galvanometer." Therefore, as all parts of the system contain water charged with both organic and inorganic substances, it will be impossible to pass an electric charge through these bodies without effecting their decomposition.

The manner in which the elements of such decomposition are absorbed and disposed of, can be rendered intelligible by reference to the mode of interchange which occurs among the elements of an ordinary voltaic circuit. Hence may also be deduced the laws of electro-deposit and solution, corresponding with growth and absorption in the system; and also the method of transference and decomposition of earthy salts, as taking place in the calcifying and decalcification of bone and dentine.

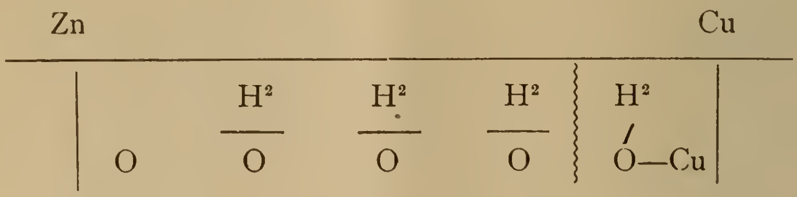
To constitute a galvanic arrangement three elements are requisite. Two of these require to be substances of different affinities for oxygen, and the third a liquid capable of being decomposed in order to furnish the necessary oxygen. Zinc, and copper or carbon, in various liquids, form the batteries in common use.



Taking this diagram to represent plates of zinc and copper with their connecting wires, and intervening molecules of water, the instant the wires are brought into contact a remarkable change takes place, as here shown.



One equivalent of the water has given up its oxygen to the zinc, and the odd equivalent of hydrogen appears at the surface of the copper. This action will continue, growing less and less until the accumulation of hydrogen upon the negative plate almost prevents further activity. Professor Daniell, by procuring the absorption of the hydrogen at the negative plate, formed the *constant* battery. He attained this by surrounding the copper plate with a solution of sulphate of copper, which was separated from the liquid surrounding the zinc by a porous partition. The oxide of copper held in solution is decomposed, giving up its oxygen to combine with the free hydrogen to form water, while the metallic copper is deposited upon the copper plate.



If, instead of joining our two wires directly, we dip their ends into a conducting liquid in another cell, a similar successive series of decompositions and recompositions will simultaneously occur in the second cell.

In most electro-chemical experiments, the voltaic battery occupies the place of the primary cell, and the thing experimented upon that of the secondary cell.

If albumen, or an albuminous substance, be made to undergo chemical decomposition, we shall have evolved, in addition to oxygen and hydrogen, a small portion of nitrogen, and about half its weight (when dried) of carbon. It is this carbon which produces the dark stains in decay of the teeth. If the carbon, in this state, be burned in the presence of a further supply of oxygen, carbonic dioxide, or carbonic acid gas, is produced. The materials for these decompositions are carried in the blood; but their separation is as purely due to electrical agencies as is the separation of the oxygen and hydrogen in the voltaic battery.

The general impression, hitherto, seems to have been that absorption is mainly, if not wholly, due to the action of the lymphatics or absorbents; and it is also believed by some that the blood-vessels do not imbibe as well as exude fluids. The rationale of electrical action will show us that both these views are most probably erroneous. The membrane in the Daniell battery is no impediment to the passage of the electric current, while it is necessary for the separation of two fluids in which contrary actions are occurring. The membranes composing the coats of the blood-vessels are so constructed as to be permeable in both directions; and as the transudation of the albuminous fluid of the blood would not arise spontaneously, or occur indiscriminately,—that is, without some controlling agent for directing the supply to where vital action rendered its presence necessary—such transudation, when it occurs, indicates the existence of such a guiding and controlling power. In electrical action we have the same conditions existing. Hence, in the case of an Haversian space, where the walls of the opening are being removed, this electro-positive condition of these walls implies the electro-negative or receiving condition of the central *contents* of the space. If there be no absorbents here, as would appear to be the case, the blood-vessels must necessarily receive the ambient matter; and, contrarily, when an Haversian canal is filling up, they would furnish albumen for the tissue, and the lime needed to harden it.

The absorption of soft substances, not undergoing decomposition, becomes a mere question of solution and imbibition; but hard ones, as bone and dentine, have first to be decalcified before the primitive cartilaginous material can be solved and absorbed. In these respects the process of absorption is simply the reverse of that of formation.

With respect to the removal of the hard element there can be little question of electrical influence. If a piece of sulphate of lime (or any other insoluble salt) be placed in water under the wires of a galvanic battery, it will be decomposed, the lime appearing at one of the electrodes, and the sulphuric acid at the other. If the current be reversed, the lime and sulphuric acid will change places. This reversal of the current, causing a change in place of the different formations, *constitutes the key to the alternating or reciprocating action of growth and absorption in the system.*

The introduction of the lime, during formation and growth, is a physical, not a vital, effect; and not only physical, but also electrical, in arrangement. Take a piece of amber or vulcanite, warm it by friction, and rasp it over a vessel of tepid water. The particles, falling upon the water, will arrange themselves in certain clearly defined formations, manifestly not the result of capillary attraction, and indicating only their electro-polar condition. This experiment, of course, shows simply the nature of the agency employed in *arranging* the materials used in organic construction.

The fact mentioned, of the effect of voltaic currents upon insoluble salts, taken together with the experiment of arrangement just noted, will indicate the possible method of absorption and renewal in living tissues, such as the changes continually going on in the Haversian systems in bones.

If a small piece of wire be suspended in a fluid between two electrodes of a voltaic circuit, the separate wire, during the passage of the current in the circuit, will become electro-polar *by induction;* that is, without touching either of the other wires, one of its ends will become positive and the other negative; and one end will be dissolved while the other is increased (See Fig. 1.)

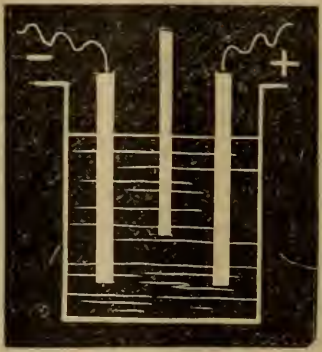


Fig. 1.

The Haversian canals and spaces, as seen in a longitudinal section of a long bone, run parallel, or nearly so, with occasional anastomoses. Now, if a *canal* be in a *negative* or *growing* state, and an adjoining *space* be in a *positive* or *wasting* state, the two may represent the battery electrodes in a former diagram; while a third canal or space, branching in between them, will fill the place of the isolated wire just mentioned, and will partake of the electrical action of the other spaces or canals, in like manner, by induction; one side wasting while the other side grows. Therefore, *to set up absorption in a bone which is negative, it is only necessary to induce an electro-positive condition of the adjoining parts.*

An electro-positive condition being set up on a surface of bone must necessarily lead to the electrolytic removal of its lime. In the absorption of bone this is invariably the first stage of the proceeding. I have not been able to discover that this fact has ever before been pointed out. To prove it, a piece of dentine may be placed in water, with the *positive* electrode touching it at a single point. At this point a pit will be excavated by electrolytic action, and the lime thus removed will appear at the negative pole of the cell (See Fig. 2.)

But if we substitute albumen for water, in the same cell, a very different set of results occurs. The instant the wires are immersed, each becomes coated with a white froth, which gradually increases until the two masses meet. Shortly afterward, a third portion spreads out between them, across the cell, and at right angles to the two poles. After the battery has been in action some ten or twenty hours, it will mostly be found that a gelatinous mass has spread out under the positive pole, and, acting as a conductor, has diffused the decalcifying effect, and caused a much larger space of the dentine to be acted upon than in the former experiment. Around the negative pole will be found a mass of clear and transparent jelly. This substance, while formed only from albumen, is entirely different in character. It is no longer like albumen, soluble in cold water or coagulable by heat. *It has become identical with the material of basement-membrane and bone-cartilage.* The portion at right angles to the two poles is of this character in its densest state; almost, if not quite, equalling cartilage in density. An examination by the microscope will show that it is also, in some parts, *thickly studded with peculiar globular crystals of lime.* In this condition it is strictly analogous to bone in the early stages of calcification.

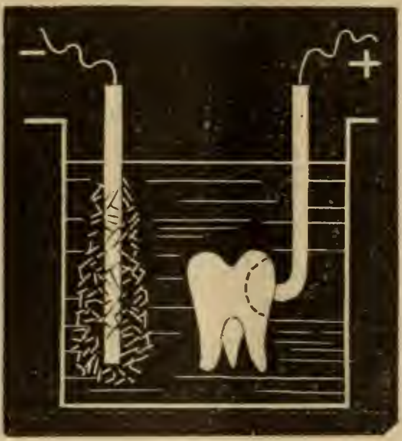


FIG. 2.

Bone has a laminar structure. Tomes and De Morgan remark that "when lamination reaches its highest degree of development, each lamina is seen to be made up of two parts—an *outer*, which is highly granular, composed often of a single line of large granules or cells; and an *inner*, singularly clear and transparent, and to all appearances without granulation or any recognizable structure."

In our artificial bone there is precisely this arrangement of a clear and transparent layer with another layer of the globular crystals attached to it. The layer of earthy matter forms at the surface nearest the positive pole, and the clear layer at the negative pole.

In these experiments, then, we get, first, the decalcification of the dentine at one pole; next, the formation of cartilage at the other; and subsequently, the introduction of lime into the cartilaginous layer. We have thus absorption and reproduction going on simultaneously, and precisely as Tomes and De Morgan have shown to be taking place in nature; so that we can scarcely hesitate to accept the fact of electricity being the agent employed in both cases.

After decalcification the basement-tissue remains to be disposed of. This may be accomplished either by the introduction of vessels and its becoming new tissue; or, in the absence of such action, the morbid results of ulceration or suppuration may follow. This view shows that ulceration of *bone* is impossible; for, before ulceration can occur, the part, through decalcification, will have ceased to be *bone*, and will have become simply "basement-tissue." We have, certainly, the death or necrosis of bone, and its exfoliation as bone; but in ulceration the first change must be the destruction of bone, as such, by electrolytic removal of its lime.

"The chemical action of voltaic electricity"—says Faraday—"is characteristic of that agent, but not more characteristic than are the *laws* under which the bodies evolved by decomposition arrange themselves at the poles." Thus, whenever *acid* appears, it does so invariably at the *positive* pole, and may be taken as conclusive evidence of that condition; while the *alkaline* state evidences the electro-*negative*. Therefore, since the external layers of the skin, the mucous membrane of the mouth, the dentine, etc., are unquestionably in an electro-positive state, they are consequently liable to the development of acidity; the source of which may be either the serum of the blood or the saliva.

Now, although there is occasional development of acid conditions in certain parts, and occurring at one time more than at another, these cases (with exceptions, as gastric juice, etc.), may be taken as somewhat abnormal; the perfectly normal action being that in which the changes happen so slowly and regularly that the elements of each acid or basis may be appropriated as fast as liberated, and so no excessive extreme condition may be apparent.

Under these circumstances it becomes easy to explain all the phenomena of dental caries, as being produced by electro-chemical action.

Dental caries has been defined as "the death and subsequent progressive decomposition of dentine." This definition supposes the vitality of dentine. But it has been demonstrated that dentine can lay no claim to vitality, in the ordinary acceptation of the term; not having in itself the power of growth, or performing any other vital function. It can be, therefore, regarded only as a *vital product*, having an organized formation, and liable to the same physical changes to which other forms of organic matter succumb. The discoloration of dentine, which has been supposed to have arisen from its "death," is shown by the chemist to be only an ordinary form of decay under certain conditions in an organic substance. It is termed, "eremacausis," or slow combustion, the peculiar feature being a gradual conversion of some of the elements, while the carbon remains as charcoal. The conditions under which it occurs, depending entirely upon adventitious circumstances, are purely physical.

During the progression of decay the lime is removed from dentine and the decalcified structure remains, invariably, more or less acid. The production of acidity in carious dentine has been attributed to decaying food; but no bulk of food possible under the circumstances would be able to produce one-half the amount of acidity often found in a small cavity; and also, were the production of the acid external, decaying teeth could never be coated with tartar, as they commonly are. A specimen may be found in the museum of the Odontologica Society, a tooth largely coated with tartar, in which the acid fluid running out of the cavity has furrowed the tartar away, by dissolving it, *immediately below* its source, thus showing the source of the acid to be *within.*

It is one of the laws of nature that, in organic matter in a moist state, stagnation leads to change. In all living forms a special organization is provided for the fluids which are required in growth to be kept in constant motion. When this organized structure is either bruised, broken down, or otherwise injured, so as to prevent the capillary action by which the moisture is passed on, the injured part is thus cut off from the circulation, and, according as it may contain little or much moisture, in time becomes decomposed or rotten.

In the organization of the tooth, the soft fibrils extend to the enamel, and sometimes into it; and as we know the enamel to be capable of absorbing moisture after being suffered to dry, we have a right to infer that it, as well as the other coverings of the cutis, is capable of giving off moisture in the same way as may be traced in the insensible perspiration of the skin; and, in fact, we have no reason to doubt this when moisture may be collected readily from over the finger-nails. We may therefore take this as a clue to some of the more obscure conditions predisposing to the commencement of decay.

It is certain that electro-chemical decomposition depends very much for the amount and rapidity of its action upon the condition of the electrolyte, or fluid element of the series; and as the state of the fluids in the system is known to vary considerably, in health as well as in disease, and to be greatly affected by various medicaments taken internally, this difference at different times is abundantly sufficient to account for the tendency to decay present at one time more than another without any very apparent cause.

It seems equally certain that the several layers of the skin are arranged, electrically, in opposite states ; that the enamel and dentine (taken together) and the tooth-pulp similarly possess opposite polarities; that these correspond in disposition and effects with a galvanic series; and that the idea of the formation of dentine as a physical result of such electrolytic action is amply borne out by experiment. Hence there can be little question as to other consequences arising from the same arrangement—"for," says Faraday, "no voltaic battery has as yet been constructed in which the chemical action is only that of combination. * * * Decomposition is always included, and is, I believe, an essential chemical part." Thus it seems that we may justly attribute the decomposing effects in decay to the same force as that employed in formation.

These electrical conditions may also serve to throw some light on a circumstance respecting which very little is at present known—that is, why some substances answer better for filling teeth than others.

In conducting the experimental researches relating to the action of the voltaic battery, Faraday starts with the assumption that, "when an amalgamated zinc plate is dipped into dilute sulphuric acid, the force of chemical affinity exerted between the metal and the fluid is not sufficiently powerful to cause sensible action at the surfaces in contact, and occasion the decomposition of water by the oxidation of the metal."

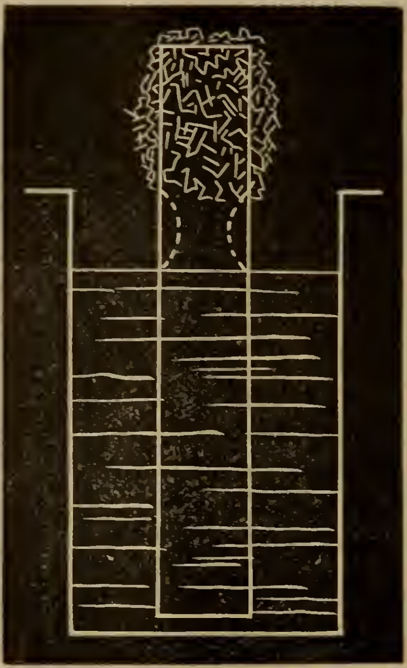


Fig. 3.

And again, "a battery constructed with amalgamated zinc, and charged with dilute sulphuric acid, is active only when the electrodes are connected, and ceases to act or be acted upon by the acid, the instant the communication is broken."

If this conclusion, however, be put to the test of experiment, it will be found to be a mistake. A rod of absolutely pure zinc, after being thoroughly amalgamated with fresh distilled mercury, was placed half its length in cold dilute sulphuric acid, the other half being exposed to the atmosphere. In a very short time bubbles of hydrogen made their appearance over the submerged surface, and after forty-eight hours the metal was found to have lost upwards of two grains in weight. This loss, however, was by far the least important of the results obtained. The immersed portion of the metal had not been acted upon *uniformly* over its entire surface; but the action had been greatest *at the surface of the liquid.* At the same time the exposed portion had become covered with patches of crystalline sulphate of zinc. Therefore, not only had chemical action been exerted between the metal and the acid, and the water decomposed, but the metal itself *had been polarized* (See Fig. 3.)

A similar piece of copper wire, *wholly submerged* in the acid, so as to entirely prevent any portion of the metal from coming into contact with the air, *remained for many months without imparting the slightest tinge of color to the liquid ;* but, on suffering the fluid to evaporate, *the instant the slightest portion of the metal became exposed to the atmosphere, chemical action commenced.*

The atmosphere in its normal state is electro-positive, and by the well-known laws of induction it renders certain bodies exposed to it electro-negative. The exposed end of the copper is therefore rendered *negative;* and the acid solution being by the same law also negative, the submerged portion of metal becomes *positive.* Hence the electrolytic action at the point of junction of these states; the *positive* part being decomposed, while the *negative* receives additions in the form of crystallized deposit.

It must be borne in mind that an electric state is not a fixity, but relative, varying as the attendant conditions. Thus, were our wire inverted, the immersed end, now positive, would become negative, and *vice versa.*

Let us now apply these facts to the mouth.

The external epithelial layer of the gum is constantly throwing off its worn-out cells, and by this wasting process determines its electro-positive condition, while the crown of the tooth, as a continuation of the epidermal layer, partakes of the like condition. Were the teeth wholly and constantly submerged by the oral fluids, and thus protected from the air, it is probable that, like the copper wire beneath the acid, they, too, might remain intact. But as the air is constantly passing through the mouth they are thus, having one end exposed to the air and the other to the fluid moistening the gums, subject to the same polarizing influence as the metals.

The principal amount of electro-chemical action has been shown to take place at or near the surface of the fluid, the latter determining the line of demarkation between the two electrical conditions. Hence, in the mouth, this line may be taken as existing at the free edge of the gums. In fact, we see decay occurring in that situation very commonly. In the interstitial divisions between the teeth the moisture accumulates by capillary attraction, and here we have approximal decay as one of the most common forms.

An amalgam filling in the side of a tooth, having one edge near the gums, generates acid at the latter point. This is due to polarization; since, as we have seen, a body of metal, having its two ends exposed under different circumstances, becomes polar; and in proportion as there is any substance to be acted upon by the oxygen, so is the amount of chemical action regulated. Thus, a metallic plug in an approximal cavity, or in the external basal area of the molars, will have the cervical edge continually wet, while the upper part may be comparatively dry, and therefore it will assume the polarized condition.

With the entire range of metals and metallic compounds, the question of electro-chemical action is one only of degree, for the one cause affects them all more or less. In this respect gold is unquestionably by very far the best of the metallic fillings, as being the least oxidizable; but even with gold certain precautions are essential to success. The one indispensable condition is *that there shall be no lodgment for moisture at any point of the circumference of the filling.*

With amalgams this precaution is, if possible, even more important. With these compounds, also, enter several other questions of grave interest. Some of the hardest of them (as zinc and copper, and their various alloys with tin and silver) pass rapidly from oxidation to the acidifying stage, while in the softer forms the mercury readily oxidizes, producing discoloration. But a more serious objection to amalgams lies in the method of their crystallization. *Amalgams hardening under a state of polarization* (as they may and do in the mouth) possess almost invariably a coarser body crystallization, with a peculiar surface crystallization, than such as harden while depolarized. With the polarized metal the crystals *project above the level of the surface*, while the body texture is coarse; but the depolarized metal, though still distinctly crystalline, has a much finer texture. Also, the polarized metal shows more discoloration of substance than the other. Finally, *all* amalgams exhibit a degree of roughness of surface which is inconsistent with a perfect filling.

It is thus seen that all metallic fillings possess certain inherent defects; and the question then arises whether these defects are insuperable, or whether they admit of remedy.

One of two remedial proceedings is indicated—*to prevent polarization;* or, *to prevent the effects of polarization being reflected upon the dentine.*

The former is not by any means difficult; but it requires a thorough knowledge of the laws under which it occurs, in order to adopt the proper provisions required to meet ever-varying indications. *Insulation*, however, is one of the means by which to prevent polarization: and it is also the remedy for attacks upon the dentine. Either gutta-percha, waxed tissue-paper, allotropic sulphur, or osteo-plastic, forms an admirable insulating lining for a cavity.

In endeavoring to illustrate our subject by a series of results which should correspond as nearly as possible with natural occurrences in the mouth, a number of new and highly interesting facts have been pointed out; and, as Sir Humphrey Davy remarks, "Concerning the publication of novel facts there can be but one judgment; for facts are independent of fashion, taste and caprice, and are subject to no code of criticism. They are more useful, perhaps, even when they contradict than when they support received doctrines, for our theories are only imperfect approximations to the real knowledge of things; and in physical research doubt is usually of excellent effect, for it is a principal motive for new labors, and leads continually to the development of truth."

DISCUSSION.

Dr. Jarvie: It appears to me that the conclusions of this paper strike a direct blow at the "new departure" theories, so lately promulgated. We have been told that "in proportion as teeth need saving, gold is the worst material to use," on account of electrical action upon the tooth-substance where gold is used. But Dr. Bridgman, from his experiments, concludes that the reverse of this is true. "Who can decide where doctors disagree?" For those of us who are not chemists or electricians, the case, so far, is certainly puzzling.

Dr. Brockway: As I understand the matter, Dr. Bridgman has neglected an important factor in the problem. If I understand Drs. Palmer and Chase correctly, their conclusion is that oxidation of a filling is an advantage to the tooth instead of the opposite, since thereby the tooth is preserved at the expense of the filling. This idea appears not to have occurred to Dr. Bridgman.

Mr. Dexter: That conclusion is a necessary consequence of the theory (evolved, as I understand, by Dr. Palmer) that each filled tooth is the practical equivalent of a single cell of a voltaic battery. It seems to me, however, that Dr. Palmer, in his turn, leaves something out of the question, or, at least, reduces it to minor importance; which something is, the influence of the electrolyte upon the other elements of the cell. The action of a voltaic arrangement depends upon the nature of the electrolyte or fluid element, as well as upon the characters of the solid elements. For instance, iron is positive to copper, in sulphuric acid or solution of common salt; but it is negative to copper when immersed in ammonia. Also, platinum is negative to zinc, in any electrolyte, but it is always positive to graphite. So that changes in the chemical character of the oral fluids will certainly vary, not only the amount, but often the direction, of any electrical current excited between the tooth and filling.

Dr. E. A. Bogue: Does Mr. Dexter mean that the chemical composition or nature of the filling material has nothing to do with the current? Is not the contrary true, that the character of the filling material has as much importance, not only in regard to its own durability, but in regard to the disintegration of the tooth, as the fluid in which it may be immersed?

Mr. Dexter: The nature of the filling material influences the electrical disturbance just as much as the character of the surrounding fluid does; but *no more.* Each is equally important in the problem.

Dr. Bogue: That is, that certain filling materials would be certainly destructive under certain conditions of the mouth and fluids, while under other conditions they would be as certainly preservative?

Mr. Dexter: Yes, sir.

Dr. Bogue: Cannot there be a filling material which shall always be positive to the dentine's negative, provided the proper fluid be always present?

Mr. Dexter: Certainly; but, to accomplish this, one must be able to insure the invariable and constant presence of such a fluid.

The weakest point in Dr. Bridgman's theory appears to me to lie in his major premise. If I understand him correctly, he asserts electricity to be *the cause of* chemical action, instead of *its result.* This is a direct negation of the chemical theory of Wollaston, Davy, Faraday, and almost all the principal physicists, besides setting up a creation of power from no assigned cause. The latter is contrary to nature; yet, since Dr. Bridgman neglects to explain whence comes the current which Smee found in the rabbit's cheek, and since he apparently upholds that writer in the assumption that electricity is "the force employed to throw the muscles into operation," (or, at least, he does not deny it,) we are compelled to believe that he thinks it possible. It is true that we appear to have originations of force; but they are all really conversions only. In no case is there any production of force without a corresponding exhaustion of something to supply it.

The presently received opinion of electricians is, that all electrical action is caused by—is the result of—chemical decomposition. This implies that chemical decomposition must precede electrical disturbance. Therefore there cannot be electrical action without previous chemical action. How chemical action, in its turn, is excited, I do not pretend to say; but it appears to me rather a hasty assumption to claim, in the face of all the proof to the contrary, that electrical force is, primarily, that excitant. Yet there are many who ascribe extraordinary and mysterious powers to this agent. It has been called synonymous with "will-power" and "vitality;" the brain, spinal cord, ganglia and nerves being, in this view, merely a system of systemic telegraph offices and conductors. It has, with many, in some measure taken the place of the philosopher's stone. Such theories I cannot subscribe to. Nor can I assent to Dr. Bridgman's electro-biological theories. Yet, whatever weakness may lie in his premises, certain of his conclusions, viewed in the light of the ascertained laws of electricity, are, I believe, unassailable, and particularly as to the action of filling materials in teeth. Much has been spoken and written by the advocates of the "new departure" which will not, it seems to me, stand the test of experiment and law; and many experiments have been made and promulgated, which, to me, often prove more powerful arguments against, than for, the positions they are intended to sustain. Any statement of scientific fact, particularly if dogmatic, should be susceptible of conclusive demonstration. So far, and in spite of many such statements, the "new departure" appears to be only theoretical, and not practical.

Dr. Kingsley: I would like to ask if Mr. Dexter includes Dr. Palmer and his theories in this criticism, and if he so replies to the papers written on this subject by Dr. Palmer?

Mr. Dexter: My relations with Dr. Palmer are, personally, of the most pleasant kind. I esteem and respect him highly, as an earnest, conscientious and able worker in a new field. In my remarks I am considering his ideas from a scientific, not a personal, standpoint. I do not intend what I have said as a reply to any one in particular, but as my view of certain theories which are being advanced before the profession.

Dr. Jarvie: To my understanding, both Dr. Bridgman's and Dr. Palmer's experiments lead to the same result. I think that Dr. Palmer, in his theory, presupposes the existence of an imperfect plug—a plug between which and the tooth fluids may enter; while Dr. Bridgman considers only a perfect, moisture-tight plug. In cases of the first kind some other material than gold might be best for the case, while, when perfect, gold would be the best. In all cases where gold can be used—where all the circumstances warrant its use—I believe gold is the best of filling materials.

Dr. Brockway: I think Dr. Jarvie overlooks the fact that in certain teeth it is impossible to introduce a moisture-tight gold plug. If the tooth is soft and porous it will be impossible to keep the plug dry in the cavity. I believe this position is taken by the advocates of the "new departure."

Dr. Jarvie: I don't think I overlooked that point. I think I made circumstances govern the case. A perfectly tight plug will prevent decay in its cavity.

Dr. Brockway: A plug may be perfect at its margins, yet be wet within, from the porosity of the tooth-substance.

The Secretary next read the ensuing paper.

TREATMENT OF DECIDUOUS TEETH.

BY WILLIAM HERBERT ROLLINS, BOSTON, MASS.

Dr. R. T. Stack, in his thesis last year at the Harvard Dental School, considered the important bearing which the death of the pulps of the deciduous teeth may have upon the eruption of the permanent set.

From specimens obtained at the dispensary and at the infirmary of the Harvard Dental School he showed conclusively that teeth with devitalized pulps had proved sufficient obstacles to prevent the eruption of their permanent successors. On the roots of these teeth with dead pulps were found polished facets, produced apparently by contact with the permanent teeth, the excavationes lunares having been almost polished out. Probably this was the first positive evidence found which proved that teeth with devitalized pulps were less capable of undergoing absorption than teeth whose pulps were living. This discovery was of great importance from its direct bearing upon the treatment of children's teeth: Dr. Stack having shown that in the incisors, for example, a temporary tooth with a devitalized pulp may so change the position of the permanent one as to cause the latter to erupt inside of the arch, giving rise to a deformity which requires extensive apparatus to regulate.

Dr. Stack's conclusions were that a tooth with a devitalized pulp was not capable of undergoing absorption: that the loss of substance in these cases was caused by the action of pus or acid and acrid fluids, resembling in no way normal absorption, finding a parallel, so far as the pus went, in the loss of weight and specific gravity which occurs in osseous sequestra.

As an example he figured a tooth which had been extracted and replaced, but which never became firm, so was again removed. On this tooth were found rough places which did not indicate normal absorption, but were due to the erosion of pus or to decomposing oral secretions which collected in the socket around the tooth. Dr. Stack was probably correct in considering that temporary teeth with devitalized pulps are a very common, and by the profession unrecognized, cause of irregularity in the position of the permanent teeth; but perhaps he is mistaken when he states that absorption cannot take place in deciduous or in permanent teeth after the death of the pulp. This, however, will be spoken of later in this article, but first it seems desirable to mention other injuries which may result to the permanent teeth from allowing temporary teeth with devitalized pulps to remain in the jaws.

Although in the oral specialty the evidence with which to support any view is to a great extent traditional, and not now accessible in printed form, yet it seems as if those who think anything about the matter are nearly equally divided as to the treatment to be pursued with temporary teeth when the inflammation of the root membrane has resulted in the formation of an alveolar abscess.

It is probable that the general practitioner, judging from results of abscess formation in other parts of the bony framework of the body, would not have fallen into the error of thinking too lightly of alveolar abscess when connected with the temporary teeth; but orists, accustomed to see, associated with the permanent teeth, chronic alveolar abscess which resisted all attempts at cure, persisting without apparent injury for years, have unfortunately in too many instances come to think there is equal immunity from injurious consequences when the abscess is connected with the temporary teeth; yet an endeavor will be made to prove that no such immunity does exist.

Those who retain the deciduous teeth, even after the formation of alveolar abscess, claim that no injury can result therefrom; that the inconvenience to the patient is less than the injurious contraction of the jaws which results from their removal, producing, as the latter does, a loss of masticating surface at a time when, if ever, the organism needs an efficient apparatus for comminuting the food. Those who do not hold this view claim that the nervous irritability produced by the constant inflammation of the root membrane, together with the ever-present tendency to imperfect mastication on account of the local pain caused by the process, more than outweigh other considerations.

Figures 10 and 11 show two views of a superior right bicuspid presented by Mr. Bright, a student of the Harvard Dental School. The patient, a young lad, presented himself at the school infirmary on account of pain in the region of the right upper molars.

On examination the remains of a temporary molar were found, while between its labial roots projected this tooth, embedded in the soft tissues, yet coming away without the employment of decided force.

Figure 13 is a diagram to show the close relations which the roots of the temporary molars hold to the crowns of their permanent successors. As absorption takes place upon the roots of the molar, the bicuspid, pushed forward by constant formation at its neck, becomes on all sides embraced by the former, separated only by a membrane thin in many places.

Now if the pulp of the molar dies, inflammation of the root membrane resulting, we shall have, in almost every case, the abscess formed around the apex of the palatine root. The result of this will be cessation of the dentine-formation in the part of the papilla nearest this point. Moreover, if the inflammation becomes extensive enough, this, together with the anatomical structure of the part which causes the pus to open on the labial wall—although this is much farther removed from the original seat of the inflammation than the palatine—will explain how the growing tooth becomes separated from the dentine papilla, with its final casting out from the system as a foreign body.

This was probably what occurred here; the inflammation, at first localized, caused dentine-formation to stop only at the point where the dentine papilla was near to the palatine root, so producing the difference in height between A and B in Figure 10, where A represents the part of the bicuspid nearest to the palatine root of the molar. At length the inflammation involved the whole surface of the dentine papilla, causing the dentine-formation to cease forever.

In vain were all attempts for finding marks of absorption upon the sections prepared from the bicuspid; so that whatever became of the dentine papilla, it was evidently not converted into an absorbent organ.

Probably a certain proportion, at least, of the cases of so-called dilaceration may be ascribed to inflammatory changes of the above-mentioned character, which do not go on to the destruction of the dentine-forming capacity, but simply stop this for a time at some point, or make it irregular, changing also the position which the formed portion of the tooth held to its germinal bed.

This is done the more gladly because the now employed explanation—that of mechanical violence—does not seem to be all-sufficient, when we consider how deeply in the jaw the growing tooth is placed; besides, in many cases there is not obtained, even on the most searching inquiry, a history which will explain how such violence could have been committed.

From the foregoing we have seen how deciduous teeth with devitalized pulps may be injurious to the permanent teeth otherwise than by preventing their eruption or causing them to appear in abnormal positions. It is hoped the observations are of immediate practical value, as they point out the necessity of more careful attention to the teeth of the first dentition.

Now to accumulate evidence to prove that teeth with devitalized pulps can undergo true absorption, as distinguished from destruction from acrid and acid substances. At the outset of search it is plain that in the case of a temporary or permanent tooth with a dead pulp, at the time of extraction there will be room for a difference of opinion as to whether the marks of absorption, if such be found on microscopical examination, were produced before or after the death of the pulp. Cases have come under observation where the absorption appeared to have occurred after the death of the pulp; yet, in order to prove that this was possible, teeth were examined which had been extracted, the root and crown filled with gold, and again replaced, to be after years the second time removed. On these teeth, figures of which are given, were found marks that to the unaided eye looked like absorption.

The history of but one of these teeth will be given, as the others do not differ in any particular which concerns us here.

The tooth from which Figures 1, 2, 3, 14 were taken was presented to the Harvard Dental School Museum by Dr. Cogswell. Its owner was a male of middle age. The tooth was extracted for pulpitis, the decay being so extensive as to render filling out of the question. Finding a union of the roots, Dr. Cogswell decided to try replacing, as the tooth was of great importance, there being no other molars on that side of the inferior maxilla.

To see if the tooth would return into the socket easily, it was pressed into place, after which it was removed from the mouth, the pulp extracted, the root and crown filled with gold, the ends of the united roots polished slightly, and then again placed in the socket, after having been out for three hours. The next day the tooth was employed in masticating beefsteak, while from the time of its replacement, for five years and eleven days, there was no sign of inflammation of the root membrane; but three days before its final removal, when it came away with the exercise of only slight force, it suddenly became very painful, preventing closure of the jaws; nor would the inflammation yield to any of the therapeutical agencies employed. This suddenly appearing pain and lameness occurs in a great majority of those teeth which, after being replaced, become firmly united with the body; in fact, Dr. Waters, who has had quite a number of these cases, has found this symptom in every one.

Probably this phenomenon is of importance, because it seems to exclude pus or the products of the decomposition of the oral secretions, as being the agents which produced the extensive loss of substance seen in the figures. Although pus burrows with extreme rapidity in the hard osseous tissue of the jaws, in twenty-four hours making a cavity from the root of an incisor directly through the wall of the alveolus, yet here it is not likely to have been the destructive agent; for cutting away hard dentine would seem not to have been moving along the line of least resistance.

In Figure 14 is a view of a part of a section taken from the tooth shown in Figures 1, 2, 3; here plainly are to be seen the bitten-out edges—excavationes lunares—so characteristic of absorption in the deciduous teeth. Figures 15, 16, 17 show the same changes in other teeth.

Clearly, then, there seems to have occurred in teeth with devitalized pulps absorption, which, from the microscopical changes wrought by it, cannot be distinguished from that absorption seen in deciduous teeth with living pulps; but if stronger proof is needed that these lunar excavations seen in teeth with dead pulps are produced, as they are admitted to be in teeth with living pulps, by the agency of living cells, a reference to Figure 17 would seem to furnish it; for here the process of absorption taking place in a tooth that has been extracted and replaced after removal of its pulp appears to have ceased at certain points, and a new formation of cementum-like tissue seems to fill up the lunar excavations.

From the foregoing observations, it seems possible for absorption to take place in deciduous teeth after the death of the pulps; yet how explain the fact pointed out by Dr. Stack, that these teeth have prevented the eruption of the permanent ones?

It is probable that inflammatory changes, resulting from the death of the pulp of a deciduous tooth, may so far weaken or destroy the thin membrane, which alone, at certain stages of development, intervenes between the most advanced portion of the permanent tooth and its temporary predecessor, that the former, driven forward by continued growth, may force its way through the weakened membrane, or advancing into the hiatus already created by suppuration, may come in contact with the surface of the root of temporary teeth, making absorption forever impossible at this point, although it might go on in other portions of the root.

Figure 12 is drawn from a micro-photograph of one of Dr. Stack's specimens; from A to B extends the polished surface, evidently too long to have been at one time created by the convex outer surface of an incisor. Probably as the part of the root of the temporary tooth, with which the crown of the permanent tooth came in contact, was polished, the latter, pushed forward by growth, slid upon the smooth surface of the inclined plane, and the polishing process went on again a little lower down, producing in time the extended facet seen in the drawing.

Summary.—First, probably Dr. Stack was the earliest observer who recognized the significance of the polished facets found upon the roots of the deciduous teeth; second, he seems also to have been the first to show that a deciduous tooth with a dead pulp proved a great obstacle to the eruption of the permanent successor.

The evidence seems to show that his statement of the impossibility of absorption taking place in teeth with dead pulps is incorrect, because absorption appears to have taken place in teeth removed from the jaw and replaced after filling the root canal.

Inasmuch as a temporary tooth with a dead pulp seems to have prevented the eruption of a permanent tooth, causing the latter, when the former was removed, to erupt in an abnormal position, it becomes important to take such care of the deciduous teeth as to prevent the pulps from dying, or if they die, to see, as pointed out by the writer mentioned, that the teeth are removed before they can injure the permanent teeth, by turning them from their proper course toward eruption.

In addition it appears advisable, when inflammation of the root membrane goes on to the formation of an abscess, that these teeth should be treated so as to keep the inflammation from becoming extensive enough to involve the dentine papilla of the permanent tooth. If the inflammation cannot be controlled, then the tooth must be extracted, for the loss of masticating surface is of less consequence than the life of a permanent tooth; nor is it probable that there is a well-authenticated case of contraction of the arch following extraction of deciduous teeth.

It seems to be the duty of the general physician, who sees more of children in early life than the orist, to keep careful watch of the temporary teeth, pointing out the necessity of having these teeth attended to before they begin to ache, for then, in almost every case, it is too late to save the pulp in a healthy condition.

It appears to be the duty of the orist to treat all cases of exposure, or approach to exposure, of the dental pulp in children's deciduous teeth with the least irritating substances which will protect the pulp from the action of decay, not using arsenic or creosote to devitalize the pulps; because, although with a great majority of pulps which are exposed, we cannot obtain a new formation of dentine over the denuded surface, yet we can keep them alive for years without such covering, by simple non-irritating fillings, and while the pulp is alive it is improbable that the temporary tooth can be injurious to the permanent successor by causing dentine formation to stop.

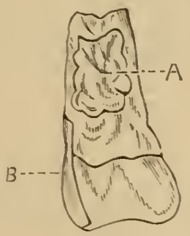


Fig. 1.

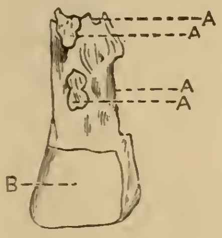


Fig. 2.

FIG. 1.—Inferior right third molar extracted and replaced, after which it was worn five years and two weeks without being lame until three days before last extraction. A is a large cavity formed by absorption after the tooth was replaced. B, gold filling.

FIG. 2.—Another view of the same tooth. Letters as before.

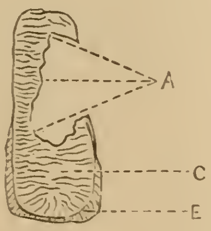


Fig. 3.

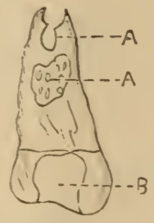


Fig. 4.

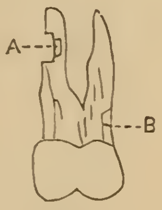


Fig. 5.

FIG. 3.—Section of the same tooth, to show the extent of the cavity A in Figure 1. C, dentine. E, enamel.

FIGS. 4, 5.—Two views of the same tooth, which was extracted and replaced, but after being used two years was again removed. Letters as in former figures.

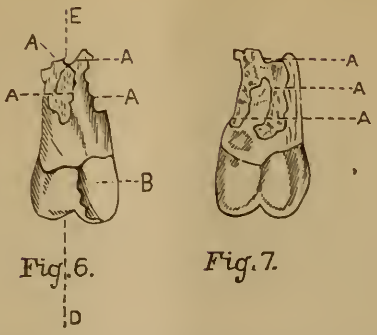


Fig. 6. Fig. 7.

Figs. 6, 7.—Two views of a tooth which was extracted and replaced. Letters as before.

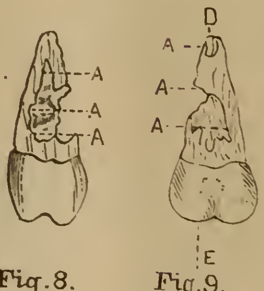


Fig. 8. Fig. 9.

Figs. 8, 9.—A reinstated molar. Letters as before.

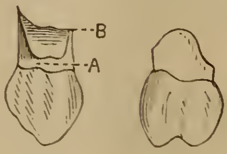


Fig. 10. Fig. 11.

Figs. 10, 11—Superior right bicuspid, in which formation ceased from the inflammation resulting from alveolar abscess on the root of the temporary molar. B shows the point where dentine formation first stopped, this being the part nearest to the palatine root of the molar.

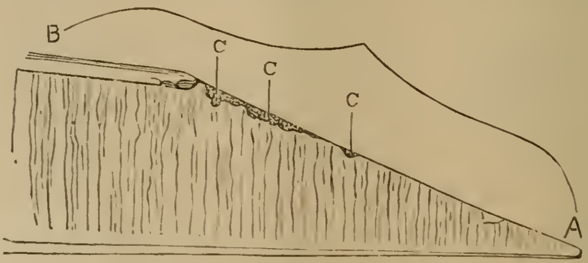


Fig. 12.

Fig. 12.—Drawn from a micro-photograph of one of Dr. Stack's specimens. From A to B extends the polished facet produced by the permanent incisor. C, C, C, remains of excavationes lunares.

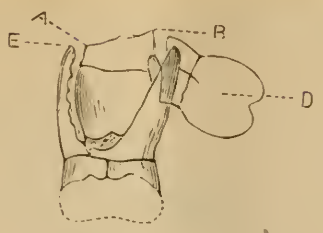


Fig. 13.

FIG. 13.—Diagram to show the relation of the tooth shown in Figures 10, 11, to the root of the temporary molar. A and B, as in Figure 10. E, the point where the abscess formed. D shows the position the bicuspid came to occupy as it was being pushed out of the system.

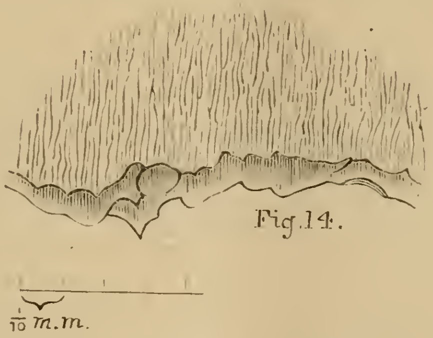


Fig. 14.

FIG. 14.—Section from tooth shown in Figures 1, 2, 3, shows marks of absorption. Section corresponds to the deep surface of the cavity A in Figures 1 and 3.

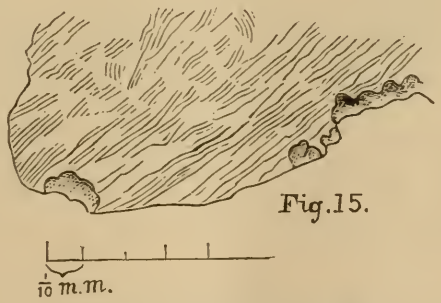


Fig. 15.

FIG. 15.—A section from tooth shown in Figures 4 and 5. Plainly to be seen are the marks of absorption.

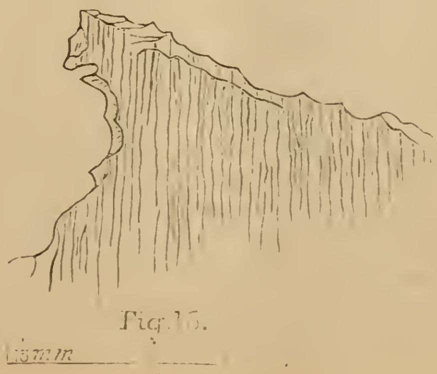


Fig. 16.

FIG. 16 —Section through the line D E, Figures 6 and 7, perpendicular to surface shown in Figure 6. The lunated edge corresponds to the deep surface of the cavity A in Figure 6.

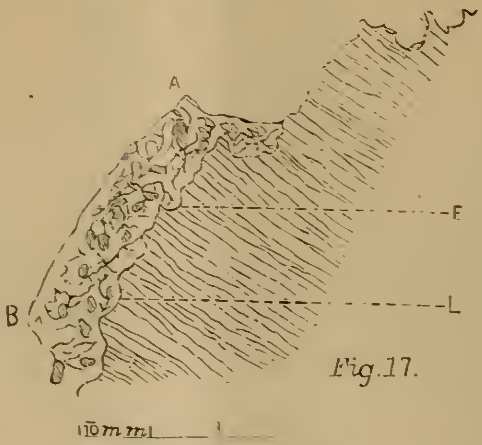


Fig. 17.

Fig. 17.—Section through the line D E, Figure 9, perpendicular to the surface of Figure 9. The new formation of cement-like tissue, A B, corresponds to the deep surface of the cavity A in Figure 8. E L, excavationes lunares filled with cementum-like tissue.

Adjourned.

Society Notices.

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Dental Selections.

NECROSIS.

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I propose to speak to you to-night of the case alluded to a few meetings since, namely, necrosis of the inferior maxilla. I will recapitulate its history.

On the 27th day of June, 1877, the patient, a married lady, thirty-eight years of age, a native of France, applied to me. Her temperament may be called the bilio-nervous. The left eye protruded considerably from the orbit, the pupil was dilated to nearly twice the size of that of the right eye, and the patient was unable to use the other eye without shading or shutting the affected one. She complained of a bad taste in her mouth since July, 1874. Her gums had been swollen for two days, in the region of the first and second molars of the lower jaw, on the left side. On the 6th of July, 1874, she had consulted an eminent oculist of this city, who (she says) told her that the protrusion and partial blindness of the left eye was due to paralysis of the optic nerve. He applied electricity, and gave medicines internally, but without beneficial result.

While under treatment a severe neuralgia developed, which involved the whole of the left side of the body, and continued with greater or less severity up to the time she consulted me. After the development of the neuralgia she had consulted further with a number of eminent general practitioners, but without gaining relief from the pain, bad taste or disfigurement.

I made a careful examination of her mouth, and found the first lower molar necrosed and loose. I advised the immediate removal of the tooth, which was assented to by the patient. I then dismissed the patient, with the request that she would see me again.

Fifteen days after, on the 12th of July, the patient returned, and, on further examination, I was convinced that this was a case of necrosis. I made an injection of aromatic sulphuric acid into the socket, and informed the patient that the bone would have to be removed; that I believed the whole trouble originated there, and that perhaps, when it was taken out, she would be entirely relieved. The patient, greatly frightened, went to one of her physicians, who did not seem to understand the case, but took her to a professor of this city, and both denied the correctness of my diagnosis. The professor said he believed there was a tumor forming, and that which the dentist supposed was necrosis was nothing but a root of a tooth, which should be extracted.

A few days after this the patient returned to me with a letter from the doctor, requesting the extraction of the root. I was surprised to receive such an opinion from such an authority. I reasserted my former diagnosis to the lady, and told her that both physicians had mistaken the dead socket, from which the tooth had been removed, for a root.

For the satisfaction of the patient and myself, I invited her to see Dr. W. H. Atkinson, who, after examination, pronounced it to be an unmistakable case of necrosis, and advised a continuation of the aromatic sulphuric acid treatment every other day. For the removal of the *débris*, I advised the patient to use permanganate of potash, ten grains to an ounce of distilled water, taking a few drops of this in half a glass of water, and rinsing the mouth with it as often as necessary.

After the ninth application of the acid I found a pretty large piece of bone loosening. I enucleated the yet attached periosteum and gum, and removed a sequestrum (measuring about one inch and a quarter in length) from the second molar to the first bicuspid tooth—almost the whole mass, in thickness and depth, of the lower jaw—leaving only the lower and outer border, and a very thin connection between the angle and symphysis, and involving the inferior dental canal, in which no living nerve nor vessel was present. I then rinsed the pocket with a solution of a teaspoonful of salt to half a pint of water, subsequently drying it with cotton, and again applying the aromatic sulphuric acid, and stuffing the pocket rather tightly with cotton.

The next day the patient was in excellent spirits; able to see with her left eye, and rid of the neuralgia, as well as of the bad taste. I dressed with wine of opium, using the aromatic sulphuric acid every third to fifth day, till the 14th of September. I then found, as I expected, the second and first bicuspids loose, and extracted them, continuing the alternate use of aromatic sulphuric acid and wine of opium.

On the 24th of September I drilled away nearly the whole bone, from the second bicuspid to the canine tooth, leaving only enough to hold the jaw together. The part from which the first sequestrum had been removed was, by this time, almost filled with healthy granulations, and, on the whole outer side, had formed a sort of provisional callus, which enabled me to take away as much as I did without breaking the jaw. The patient, in this condition, was, of course, not able to eat anything but soft or liquid food. Continuing the dressing as before, small spiculæ of bone separated and came out with the cotton dressing, or were removed by the forceps

On the 12th of November, the canine, and shortly after, on the 24th, the central and lateral incisor teeth of the same side became loose, and were removed. After this my patient became so weak and nervous that I was obliged to give up the acid treatment, using only the wine of opium daily, after thorough cleansing with salt water, requesting the patient to take plenty of out-door exercise during sunlight, to eat oysters, eggs, etc., drink wine or porter; in short, to live on highly nutritive semi-solid food.

On the 15th of January, 1878, I removed the rest of the dead bone, extending from the canine tooth to the symphysis. This I accomplished as before, with the large round burr of the engine, leaving but a thin plate of the body of the lower jaw, which I was sure was healthy. After this I made a few more applications of aromatic sulphuric acid and wine of opium, and to-day the patient is well. She has had no more neuralgia nor bad taste; can see with the left eye, though not as well as with the right one; but she is satisfied, and I am too.

How is it to be explained that such general disturbances arose from a piece of necrotic bone in the jaw? I think in the following manner. By a reflex irritation of the inferior dental nerve upon the submaxillary and otic ganglia, which are in connection with the anterior branches of the superior cervical ganglion, and in direct connection with most of the cranial and some of the spinal nerves, the almost constant neuralgia on the affected side is easily explicable. The bad taste I believe had a double origin: first, directly from the necrotic point; secondly, from perverted action of the gustatory nerve, a branch of the inferior maxillary division of the fifth; lastly, as to the dilatation of the pupil, I think it resulted from paralysis of the iris and ciliary processes, the protrusion of the eyeball from a relaxation of the recti muscles, brought on, I believe, by the irritation of the ciliary ganglion in connection with the third nerve (motor oculi), which supplies all the outer muscles of the eye, except external rectus and superior oblique, and the short ciliary nerves distributed to the ciliary muscles and iris.

Now as to the microscopical differences between normal and necrotic bone. The successful study of the elements of bone-tissue depends very much upon the method employed. The proper examination of bone-tissue originated in the second and third decade of this century, and was pursued by Howship, Havers, Henle and others; all of whom resorted to dry bone, which they divided into thin slabs by the use of the saw, after which these were ground thin by a variety of devices, reducing each specimen to semi-transparency. Observations made in this way resulted in the theory of canaliculi bearing a solution of lime salts, hence the name "canaliculi calchofori." In 1850, Rudolph Virchow and F. C. Donders applied the cell doctrine of Schwann to the explanation of bone-tissue. They sometimes used dry and sometimes fresh bone in their investigations, macerating it in dilute hydrochloric acid, whereby they liberated the elements of the structure more or less distinctly. The bodies so isolated presented, sometimes, nucleated structures connected together by branches; at other times, completely isolated bodies consisting of a central mass with projecting processes, and to these they gave the name bone-cells. Donders, in 1853, drew attention to the fact that bone-tissue had spaces filled by cell-like structures similar to those of other kinds of connective tissue. E. Neumann, in 1863, asserted that the so-called bone-cells were not the cells designated by Schwann, but spaces with offshoots having a more densely calcified wall than the other basal substance, and thus better able to withstand the reaction of solvents. These bone-cells are no other than the lacunæ, and their offshoots the canaliculi. Virchow came to believe that the cells were enclosed within the lacunæ, though without filling the whole space, and to this day adheres to the cell doctrine of Schwann, and claims it to be the only possible explanation of the bone-cells being inclosed in the lacunæ and their offshoots, containing a fluid, and ascribing to them the property of life, forgetting that a fluid as such is not endowed with life.

Inasmuch as the dry method of examination of bone-tissue prevailed exclusively up to the introduction of the wet method, by Heinrich Müller, in 1856, it is not surprising that it is frequently persisted in to this day. The nearer to the living state the examinations can be made, the more instructive and definite will the observation be. Hence the dry method is fast falling into disuse among those making histological researches.

In 1871, Edward Lang introduced the examination of living bone under the microscope upon the heated stage, by which he noticed amœboid motion in bone-corpuscles. By this management the lacunæ were proved to contain protoplasm, but the nature of the contents of canaliculi he said nothing about. The method of examining bone-structure introduced by Heinrich Müller, viz., to decalcify bone by the use of a solution of chromic acid, is to be preferred. Fresh, living bone should be introduced into a solution of chromic acid of from a half to one per cent., to which may be added, to hasten the decalcification, on every second or third succeeding day, a few drops of dilute hydrochloric acid. The vessel should be emptied and the fluid renewed about every fifth day. In this way bones are decalcified in a short time, and without considerable change. For thin bones two to three weeks are sufficient to soften them enough to produce sections of any degree of thinness by the use of the razor. Such sections may be stained by placing them in a solution of chloride of gold, of one-half to one per cent. in strength. An examination of such preparations will show that, within the lacunæ of the bone, nucleated protoplasmic bodies are to be seen, with finely granular offshoots extending into the larger canaliculi, where they are lost to sight. From the surface of the protoplasmic body in the direction of the basis-substance many conical processes protrude towards the small canaliculi, with which they blend.

In 1873, C. Heitzmann described the net-like structure of protoplasm, and also observed the same arrangement in the protoplasmic bodies within the bone. He describes the net-like structure thus: "The nucleolus is connected with the wall of the nucleus, and this again with the granules, by very fine threads, which are to be regarded as the living matter proper, while the fluid contained within these meshes does not possess the property of life."

One year before, namely, in 1872, this observer described and illustrated a bone-corpuscle from bone in the early stage of inflammation, in "Wiener Medicinische Jahrbücher," 1872, Plate IX, Fig. 3. This plate shows very plainly the shining, nearly homogeneous-looking bone-corpuscle, with offshoots in every direction, filling the whole calibre of the canaliculi. It solves the question of the contents of the canaliculi in bone, by direct observation. The living granular protoplasm in bone behaves precisely as in other tissues under the influence of the inflammatory process—that is to say, the central mass becomes a shining and nearly homogeneous lump, the offshoots from which occupy the whole calibre of the canaliculi, and by this the analogy of bone to all other tissues is established. That is to say here, as elsewhere, the living part of the protoplasm forms a continuous net-work throughout the whole animal body, in the meshes of which a more or less fluid basis-substance is found, differing in its chemical properties in different situations, which in bone is glue-giving, and infiltrated with lime salts.

I have followed the methods, in my examination of bone-tissue, as above described. This enabled me, by the use of the razor, to obtain sections fit to be examined by an immersion-lens magnifying 800 to 1,000 diameters. I noticed that the canaliculi could be plainly seen in sections, the basis-substance of which had retained a small quantity of lime salts. In completely decalcified specimens they are very faintly discernible. According to my experience, it is better to stain the sections with a solution of chloride of gold of the half of one per cent., whereby a better view of both protoplasm and basis-substance is obtained. Another good way is to stain the sections with carmine and hæmatoxylin.

The results of my observations with high magnifying powers, 800-1,000 diameters, are, that bone tissue presents faint parallel lines, dividing it into the so-called lamellæ, within which we find the bone-corpuscles, the shapes of which vary according to the direction of the cut and of the lamellæ. As bone-corpuscles are flattened lenticular bodies, we will recognize them in this shape in the front view only. Longitudinal sections through these bodies give a spindle-shaped outline, small when cut near the boundary, broad when cut through the middle line of the lentil. A cross-section through a bone-corpuscle shows a somewhat irregular body. A cross-section from the compact bone of a lower jaw presents invariably bone-corpuscles in all three varieties.

Figure I shows three bone-corpuscles from the lower jaw of a man about thirty years of age, who died of an aneurism. All three bone-corpuscles are drawn in the front view, as seen by an immersion lens of T. Grunow's, of this city, magnifying with the eye-piece, 1,000 times. The basis-substance I have drawn a little darker than a chloride of gold or hæmatoxylin preparation would appear under the microscope, but it will give a clearer idea of the whole. In Figure I we see three large spaces, showing a number of ray-shaped off-shoots. Besides these coarse off-shoots, innumerable extremely fine light ones are present. The larger, as well as the smaller, all communicate with each other in this way, forming a delicate net-work through the whole of the basis-substance. Within the three lacunæ of Figure I are present protoplasmic bodies. We observe in the centre of the protoplasmic bodies, *a* and *b*—a shining, oblong nucleus in *a*, and a round one in *b*, in which the nucleoli are not distinctly visible. Around the nuclei we see a narrow seam, traversed by numerous very fine threads, which are cone-shaped. Their bases are directed towards the nucleus, from the periphery of which they arise, while their points are in connection with the nearest granules of the protoplasm. Within the protoplasmic substance there are finer and coarser granules, all being connected with each other by very fine threads. The seam around the nucleus, as well as the spaces between the meshes of the threads, are observable, being much lighter than the latter.

From the periphery of the protoplasmic body numerous thick off-shoots enter the larger canaliculi, which sometimes can be followed up until they communicate with the protoplasm of other large neighboring canaliculi. Besides these many very fine off-shoots run from the periphery of the protoplasm contained in the larger canaliculi towards the basis-substance. Some of them can be seen to enter the fine canaliculi, but their course cannot be distinctly followed. Figure I, *c*, shows a protoplasmic body without nucleus; probably this has been cut near to its periphery without touching the nucleus. C. Heitzmann states that the nucleus, the granules and the threads represent the living matter which fills all the coarse canaliculi. My preparations show a much finer net-work within the basis-substance than C. Heitzmann's figure before alluded to. Though I am not able to distinctly demonstrate the presence of living matter in the finest canaliculi, yet, as we find it in all other kinds of connective tissue, I am justified in assuming it. In normal bone the lacunæ and canaliculi are not entirely filled by the living protoplasm. On the periphery of each protoplasmic body we see a distinct light seam, traversed by the off-shoots, which, in a cross-section, only show the living part of the protoplasm in the centre of the canaliculus, hence leaving sufficient space for the nutrient circulation.

The minute changes of necrotic bone are very interesting, but it is impossible to study the differences between it and normal bone if the specimens be prepared from dry osseous tissue.

I have made microscopical examinations of necrotic bone from the lower jaw, in the foregoing case, and from another piece from an upper jaw removed by Dr. Frank Abbott. The methods employed were exactly the same as before described from normal bone. In both cases the necrotic sequestra, as soon as they had been taken from the mouth, were put into the solution of chromic acid, and cut in due time. As these pieces were small, I embedded them in a mixture of paraffine and wax (after the extraction of the water by treatment with alcohol for twenty-four hours), whereby I was enabled to obtain extremely thin sections, some of which I stained with chloride of gold, some with hæmatoxylin, and some I mounted unstained.

The results of these examinations were as follows :

The outer surface of the necrotic bone, which, to the naked eye, looked rough and eaten out, when brought under the microscope showed bay-like excavations, known formerly as "Howship's lacunæ," in which there was visible a granular mass mixed with pus-corpuscles. In the middle of the bone I found all the Haversian canals more or less enlarged, some showing the bay-like excavations. The contents of the Haversian canals were everywhere the same—a conglomerate mass of darkly-shaded granules, which I was unable to stain with carmine. These masses are the same that we see in decomposition of organic matter—"micrococci." Here and there some medullary corpuscles and multinuclear protoplasmic bodies (myeloplaxes of Robin, giant cells of Virchow) were recognizable. I did not see blood-vessels in any of the Haversian canals. In the necrotic bone I found the traces of former osteitis. The enlargement of the Haversian canals and lacunæ are direct proofs of this ; the dissolving out of the basis-substance on the periphery may, on the contrary, have been due to chemical changes, produced by infiltrations from the neighboring inflamed tissues. Billroth has shown that if pieces of bone or ivory are driven into living bone, in which they excite inflammation, they will afterwards exhibit a peculiar dissolving out of basis-substance analogous to that which we see in the primary stage of inflammation. The Haversian systems and concentrical lamellæ were unchanged. The lacunæ and canaliculi were yet preserved. In the necrotic preparation from the lower jaw, I observed many lacunæ, in which the protoplasmic body, with its living net-work, was yet distinguishable, especially where the sequestrum had been attached to the periosteum. I found, also, in the preparation from the upper jaw, some comparatively unchanged bone-corpuscles. But the majority of the bone-corpuscles, and especially in the neighborhood of the Haversian canals, had the appearance of a Roman numeral II; they were either empty, or their protoplasmic bodies were shriveled up (probably the remains of the living matter), only showing a few coarse granules, illustrated in Figure 2, *a*, *b;* but no signs of fatty degeneration could be seen, for the granules were stained violet by chloride of gold. Many lacunæ, as in *c*, showed no structure at all, the contents looking rather like a mass of coagulated albumen. In none of these lacunæ was the characteristic structure of protoplasm recognizable.

To sum up my observations, I found—

First. The lacunæ contain a protoplasmic body, with a distinctly-visible net-like arrangement, to be regarded as the living matter of the protoplasm.

Second. The basis-substance is pierced by numerous coarse and fine canaliculi, communicating with each other, as well as with the lacunæ.

Third. The protoplasmic bodies, which do not quite fill the lacunæ, send offshoots of the living substance into the canaliculi, but can only be seen in the coarser ones.

Fourth. In necrotic bone, traces of former osteitis are visible, but no blood-vessels present in the Haversian canals, which are filled with micrococci.

Fifth. In necrotic bone, most of the lacunæ contain no protoplasm, but either a coarsely granular or a structureless mass—remnants of the living matter and coagulated albumen.—*Cosmos.*

INTERGLOBULAR SPACES.

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The interglobular spaces of dentine were first described by Czermak. That part of dentine which contains them is designated by Tomes as the granular layer. It consists of globules and interspaces, and might with even greater propriety have been called the globular layer.

If an imperfectly calcified tooth be prepared for microscopic examination, by mounting rapidly in inspissated balsam, so as to prevent the spaces from being filled, various spherical and rounded forms are seen. Between these rounded spheres or outlines are dark interspaces which are known as the interglobular spaces. They appear to be similar in shape to the fragments left after cutting crackers from the rolled dough. There is an annular fragment left, concave on all its sides; or there may be several concavities on the sides—a series of curves. When these globules meet, a triangular space is formed with concave sides entirely isolated from the other spaces. Or there may be a larger space of great irregularity, and bounded by many of these curved lines and angles. To demonstrate these, boil a thin slab of dried dentine in wax. The spaces will be filled and rendered opaque; the globules will be transparent.

There is another method of preparation which has some advantages. Stain a slab of dentine with Beale's carmine fluid. By careful manipulation the uncalcified animal substance which now fills the spaces will be stained, and will be shown in sharp contrast with the unstained globules.

In making your selection of teeth from which to obtain specimens of interglobular spaces choose from a rachitic child if possible. The interglobular spaces are extremely abundant in the teeth of such children.

Mr. Salter has made the observation that the interglobular spaces are nearly always to be found in the teeth of weakly organized girls with fair hair, and thin, transparent skin. In any case of constitutional weakness of the tegumentary system to which the teeth belong, we may look for deficient calcification of dentine; or, take a tooth exhibiting atrophy of the enamel; you will find abundant interglobular spaces beneath the defective part. Syphilitic stomatitis coming on while the teeth are undergoing development (or indeed any form of stomatitis) is likely to result in interglobular spaces; or, if serious and depressing diseases supervene while dentine is being laid down, they are pretty nearly sure to interfere with complete fusion of calcification globules. The specimen once obtained, it is to be prepared in the ordinary way until it is thin enough to be put up. Now treat as directed above.

The dentinal tubes may be seen passing through the globules and stretching across the interspaces of the calcified matrix. That these tracts take carmine from the staining fluid may be regarded as evidence that they are uncalcified, while the globules resisting the staining fluid in the main, conduct themselves like all perfect dentine.

It seems to be generally true that tissues that are not calcified, but are about to become so, resist the action of acid or alkaline reagents more stoutly than those denser tissues which have been completely consolidated by infiltration of lime salts. Thus lacunæ may be entirely dissolved out of bone or cementum and exhibited free from their attachments. The same is true of the half calcified lining of the Haversian canals which are freed from their connection by maceration in acids. Or, the sheaths of Neumann, which are on the verge of calcification, are readily dissolved out of the harder dentine by hydrochloric acid, and may thus be shown passing through the now slimy intertubular substance, like pipe-stems imbedded in thin mortar.

Now it is a fact that the interglobular spaces will also resist the action of reagents until the tissues about them are all dissolved away and they are quite isolated. And this fact may be taken as evidence that they too have undergone that transformation peculiar to tissues about to become calcified, although the calcifying material has not been deposited. Like the other examples given, they serve to illustrate to us that remarkable power of resistance to corrosive agents which all tissue exhibits just prior to calcification. It is plain that although they have not yet received a deposit of salts, they have undergone those changes that precede calcification.

Thus the interglobular spaces are to be looked upon as tracts of dentine that have not yet become hardened through a deposit of mineral salts. They consist of soft parts of the matrix that have been cut off from further calcific supply and left uncompleted.

In order to understand these curious spaces, we must consider that the calcification of normal dentine goes forward by the formation of globules of hard dentine in that part of the pulp which is at the same time undergoing transformation into matrix. These calcification globules first form as points which enlarge evenly and approach each other, finally fusing and blending so completely that all traces of their outlines are obliterated, and only perfect dentine remains. We might call these first globules points of ossification. The process differs from that which has been described in bone formation in many ways, and yet there is this in common: calcific matter in each case begins to be laid down in points, and spreads from these, the points becoming granules, the granules becoming globules.

In dentine formation the globules are very minute indeed at first, and increase by the laying down of salts in the animal matrix at their surface, thus enlarging them until they touch and blend. As additions continue, the angular spaces are filled, and thus in the perfect tooth no interglobular spaces are left.

If the calcification is arrested by morbid processes or defect of nutrition, the spaces between the globules remain soft and unaltered. When normal processes are resumed, a further formation of dentine may occur, leaving this unfinished, which is thus cut off from the normal supply of phosphatic salts and from complete calcification, and thus the tooth contains millions of globules with soft spaces between, instead of being formed of solid dentine.

These imperfectly calcified teeth are found in various stages of imperfection. In some there are but the faintest indications of incomplete calcification, in others there is a moderate degree of porosity in parts of the tooth. In others still a larger part of the dentine seems to be made up of granules and spaces massed together.

I have already called attention to the fact that the dentinal tubuli pass through the interglobular spaces. They may be seen to pass from the globules to the matrix of the interglobular spaces, and make their way into another globule on the other side. Thus they preserve their continuity from pulp to enamel as if there were no uncalcified tracts in the dentinal matrix.

There is no break in the regularity and perfect formation of the soft cartilage of the dentine, but only a failure of the globules of calcification to increase normally up to the point of perfect fusion with each other, so as to obliterate the uncalcified tracts between them. Of course the structural elements of these uncalcified spaces are the same before calcification as afterwards. Had normal processes gone forward to completion, they could only have resulted in hardening the previously soft dentine of the interglobular space. Thus calcification produces no structural change. It does, however, produce a very great change in density. This may be seen when a tooth containing interglobular spaces is extracted and dried; the soft contents shrink until the spaces seem empty and take up foreign matters in which they are soaked or boiled.

Mr. Tomes has remarked that the soft contents of these spaces appear sometimes to undergo calcification at a period subsequent to their formation. In this case a record of the original defect is preserved in the tooth. Faint markings remain, by which the eye may dimly trace the contour of the globules, and their interspaces now obliterated by the further progress of calcification occurring at some later epoch in life. Teeth which present these characters are said to resist decay even more persistently than those of average normal tissue. It is probable that their structure is more dense. But on the other hand, decay finds little to oppose its progress in dentine containing the uncalcified interglobular spaces. The corrosive agents at work take rapid possession of the dentinal areas thus affected. When caries attacks such dentine, its ravages are greatly to be feared, for the porous character of the tissue renders it peculiarly easy for the acid agents of decay to make their way into the tissue and withdraw its already deficient lime salts.—*Transactions Michigan Dental Association.*

ORAL SECRETIONS.

BY G. S. SHATTUCK, D.D.S.

Of all the subjects which the dentist has to consider in the rounds of his daily practice, the oral secretion stands high in the list. But a majority of them give it but little thought. They do not seem to realize the important part this fluid plays in "taking down the lime salts," of which the teeth are chiefly composed, or protecting the teeth while nature is repairing an injury.

There seems to be a tendency on the part of dental practitioners to treat and repair the effects, and pay little or no attention to the causes. Many of them never give the chemistry of these or any other secretions a moment's thought; while a few of the more liberally educated among us, with litmus, microscope and test tube are searching after the active elements which make such inroads upon the teeth.

In speaking of the oral secretions, we mean those secreted by the glands whose ducts open into the oral cavity, with which you are all familiar. The saliva from the parotid gland is pure and clear. The secretion from the sublingual is the same as that from the parotid, with the addition of sulphocyanide of potash.

The secretion from the submaxillary is more viscid and ropy. The specific gravity varies from one thousand and two to one thousand and four, taking water as the standard one thousand. We do not find the saliva as pure as when secreted by the several glands. The organic decompositions are so great, and so varied, that to take a sample of saliva and give different portions to different chemists no two of them will send in the same results.

Physiology teaches us that, in order to properly protect the teeth against acid taken by food or arising from any cause, the saliva should have an alkaline reaction. But we do not always find it so. We find it acid in a majority of cases. In one hundred cases examined by the writer it was found acid in seventy-five, neutral in three and alkaline in twenty-two.

By taking the results of a great many analyses, I find the following substances have been detected in the saliva:

Salts of lime and soda generally as phosphates, and to these the alkalinity is undoubtedly due. Calculi of salts of lime are not very unfrequently found. The so-called tartar which is deposited upon the teeth, is composed of phosphate of lime and some organic matter.

The acids are hydrochloric, nitric, sulphuric, carbonic, acetic, oxalic, uric, lactic, etc.

The chemical test for hydrochloric acid is to add to a small portion of saliva in a test tube, a few drops of a solution of nitrate of silver, and if any HCl be present a white precipitate will be formed, insoluble in acid, soluble in ammonia.

Sulphuric acid has been found once by Professor Vaughn, I believe, but we have seen results in many cases which lead us to believe it must have been present, as in "black decay," and it is not at all improbable that it is present. In all albuminoids we find sulphur, and by the action of nitric acid upon this it would be changed into sulphuric acid. Chlorine and water would do the same thing. A great many other oxidyzing agents would have the same result. The chemical test for sulphates or sulphuric acid is to add a solution of barium chloride, and if any sulphuric acid is present a white precipitate is formed, insoluble in acids or alkalies. A great deal of the food contains nitrogenous material, and nitrogen is liberated from this in one of many ways as an oxide or as ammonia ($N H_3$), and in either case would be changed into nitric acid by further oxidation. The chemical test for nitric acid is, add to a small portion of sulphuric acid in a test tube some ferrous sulphate, then drop in some saliva, and if nitric acid is present a brown ring will be formed.

Acetic acid is taken with the food. The chemical test for phosphates is to add a solution of uric acetate and sodic acetate, and a white precipitate will be formed.

Uric acid is sometimes found in the saliva; its presence is probably due to the failure of the kidneys to perform their work. The uric acid is left in the blood, and may be in the saliva from this cause. Long retention of urine may also have some effect. The test for uric acid is to evaporate a small portion of ammonic hydrate, and if any uric acid is present you will get a crimson color.

Urea may be present, and may be detected by the microscope after adding nitric acid to a small portion of saliva on a glass slide; crystals of nitrate of urea will be formed. They are rhombic plates, soluble in water.

Urates may also be present, and may be decomposed by nitric acid, and the test for uric acid applied.

Lactic acid is formed by the decomposition of lactate of soda. This is not found very often.

Carbonic acid is found. The chemical test is by adding acetic acid and examine under the microscope for effervescence of carbonic anhydride.

Oxalic acid is found also. It is one of the fruit acids. The chemical test is, add solution of calcium and oxalate of calcium—crystals can be detected under the microscope. They are octahedral.

Sulpho-cynanide of potash is secreted by sublingual gland. It may be tested for by adding some ferric chloride, and a blood-red color will be the result. This color is destroyed by the addition of a solution of corrosive sublimate.

Albumen is found in the saliva. The test is heat, and it will be coagulated and this will not be soluble in acids.

Mucine is found in saliva, and to this the saliva owes its viscidity.

Ptyaline is found, and may be obtained for practical examination, by digesting the parotid gland of an ox or sheep in alcohol for twenty-four hours, then strain and place in glycerine and strain again. The ptyaline being soluble in glycerine, would be left from any coloring matter which the alcohol might have dissolved, and will appear in white flakes.

Pus and blood may also be found, and can be seen under the microscope. There will be an excess of albumen if either blood or pus is present.

Cholestrine may be present. It comes from the nervous system. It is soft, like albumen, soluble in hot alcohol, deposited when cold in flat plates. The microscopical test is the best one. When pure, if sulphuric acid is added you will get a play of colors.

Milky saliva is sometimes found in females during lactation. Contains oil globules which may be seen under the microscope.

The sugar found in saliva may be of two kinds, grape and lactose. Grape sugar may be in saliva because there is a superabundance, or because it is not assimilated. Lactose very rarely occurs in saliva. Only one case recorded, and that one doubtful. Sometimes medicinal substances taken internally are found in the saliva, as iodine, bromine, mercuric chloride, etc.

According to Berzelius the teeth consist of the following substances:

Phosphate of lime, carbonate of lime, fluoride of lime, magnesic phosphate, sodic chloride, gelatine, and water. All of which salts, with the exception of fluoride of lime, are soluble in the acids found in saliva. The fluoride of lime is, however, sparingly soluble in cold nitric or sulphuric acids. So we can readily see the effects of the oral secretions upon the teeth when they remain in this abnormal condition for any length of time.—*Dental Register.*

ANALYSIS OF NORMAL SALIVA.

BY B. F. MILLER, D.D.S.

There are several difficulties to contend with in the analysis of saliva, either normal or abnormal, which are as follows: First, it is usually used as fast as formed, and is not very easily collected. Second, it decomposes the most rapidly of all fluids of the body, with the exception of bile, and we must take into consideration the fact that it is decomposed. Third, the tests are so delicate for some of the constituents, that great care must be taken to have everything perfectly clean. By mixed saliva is meant that from the parotid, submaxillary and sublingual glands, and the product from the mucous membrane of the mouth. It is of a pale bluish color, and when fresh has no odor; after standing for some time there is a deposit of mucus and pavement epithelium.

Methods of obtaining mixed saliva:

First. Thoroughly cleanse the mouth with cold water, open the mouth, press up under the chin and tickle the fauces with a feather, so as to produce nausea, but not vomiting.

Second. Cleanse the mouth as in the first, and chew a glass stopper.

Third. Touch the tongue roof of the mouth and fauces with some irritating substance, such as citric acid.

Fourth. Tantalize the lower animals.

Fifth. The œsophagus of the lower animals may be cut as low down as possible and saliva obtained mixed with the food.

The second method is perhaps the best. Saliva from the separate glands is usually obtained from the lower animals by salivary fistula, tying ducts, etc. Saliva from the parotid gland may be obtained from the human subject by introducing a silver canula into the orifice of Steno's duct. The saliva from the parotid is perfectly clear and transparent; that from the sublingual will be the same as from the parotid, with the exception of KCy from parotid, and that from submaxillary is thick and viscid.

The specific gravity may vary from 1002 to 1009, but is usually between 1004 and 1006.

ANALYSIS OF NORMAL SALIVA.

Take some saliva and mix it with three times its bulk of distilled hot water, and filter for the inorganic constituents.

Chlorides are always present in normal saliva in a combined state: if free HCl exists, the saliva is in an abnormal condition. Chlorides are often absent in pneumonia and other inflammatory affections; the reappearance of them is a sign of improvement.

Test.—Filtrate$+HNO_3+Ag\ NO_3=$ a white precipitate of Ag Cl insoluble in acids but soluble in ammonia.

Phosphates may be excessive or deficient. They are in excess in exhaustive nervous diseases, in excessive brain work and in rickets, but deficient in pneumonia.

Test.—Filtrate$+HC_2H_3O_2+$uranic acetate$=$a white precipitate of uranic phosphate.

Test for *Calcium.*—Filtrate$+(NH_4)_2C_2O_4=CaC_2O_4$, which will seldom if ever be crystalline; if at all, it will be in the form of oxalates. It is insoluble in $HC_2\ H_3O_2$ but soluble in HCl.

Test for *Magnesium.*—Filtrate$+Na_2HPO_4+NH_4Cl+NH_4\ OH=$ a white and flaky precipitate of $MgHPO_4$.

Potassium sulpho-cyanide is a constituent of parotid saliva, and cannot always be found in mixed saliva, as it is not very abundant even in the parotid saliva. It is more abundant in the saliva obtained from children.

Test.—Filtrate$+HCl+Fe_2Cl_6=$ a blood-red solution of $Fe_2(CyS)_6$.

There is a difference of opinion as to whether carbonic acid is a normal or an abnormal constituent, but I believe it is abnormal. I think it is due to letting it stand in air; by so doing it receives H_2CO_3 from the air. Fresh saliva never contains it.

The action of normal saliva on litmus paper is, I need hardly say, that of all new volatile alkali, viz.: that it turns litmus paper blue, and is not affected upon exposure to the air.

The principal organic constituents of normal saliva are albumen, mucine and ptyaline.

Albumen.—There are two tests for albumen. First, if saliva be strongly acidified with HNO_3 it becomes more turbid; if it then be boiled it becomes clear and of a yellow color, this showing the presence of albumen. Second, if to a portion of saliva a mixture of $HC_2H_3O_2$ and K_4Cfy be added a white precipitate is produced.

Mucine.—Saliva owes its viscidity to mucine. Most of the viscid fluids of the body contain mucine.

Test.—To some saliva in a small beaker add $HC_2H_3O_2$ gradually stirring with a glass rod for fifteen minutes, when the mucine will be coagulated in white stringy flakes.

Ptyaline is the fermentable substance of saliva. There are two methods of testing for it.

First.—Collect a considerable quantity of saliva and acidify it strongly with H_3PO_4; then add milk of lime until the mixture is faintly alkaline, and filter. The ptyaline is now on the filter-paper, but contains many impurities. Remove the filter-paper with contents to a clean beaker, and add distilled water, not to exceed the quantity of saliva originally used, and stir well, then filter again. The ptyaline is now in the filtrate, and may be precipitated by the addition of absolute alchohol.

Second.—As ptyaline exists already prepared in the salivary glands, it may be obtained from them more easily and in greater quantity than from the saliva. The parotid gland is the best to be used. Take the parotid gland of an ox or sheep and cut in very fine pieces; then place it in absolute alcohol and cork it up for twenty-four hours; then filter through cloth and squeeze the residue to get rid of as much alcoholic extract as possible. The cake thus obtained contains the ptyaline, and should be placed in a beaker with glycerine, stirred frequently for twenty-four hours or more; then filter through cloth; then filter the filtrate through paper and add to the filtrate alcohol. Ptyaline will be precipitated in white flakes, and may be collected and used as a ferment. I think the time will come when ptyaline will be obtained in this way, and used in medicine to a considerable extent.—*Dental Register.*

A TREATISE ON THE ANOMALIES OF THE DENTAL SYSTEM IN THE HUMAN AND OTHER MAMMALIA.

BY DR. MAGITOT.* REVIEWED BY DR. TH. DAVID.

The important work which we propose to review here is the latest of many publications which we owe to the same author, touching a certain number of questions relative to the anatomy and pathology of the mouth and the teeth.

The anomalies of the dental system are extremely numerous and varied; and, though they have often attracted the attention of observers, we must acknowledge that, until now, our researches upon this point consist in materials, precious, it is true, but remaining scattered and without any connection. To M. Magitot belongs the credit of having united these in one whole work, of having examined them following a vigorous scientific method, and of having given an exact interpretation.

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* 1 vol. in 4to, avec atlas de 20 planches dessinées par Nicolet, chez G. Masson, Paris, 1877. Prix 40 fr.

Translated from the Progrès Dentaire for the DENTAL AND ORAL SCIENCE MAGAZINE, *by R. H. M. D.*

Etienne and Isadore Geoffrey Saint-Hilaire, also, the immortal authors of the teratology, have decided that all anomalies of organization represent disorders, or, to make use of their own expression, imperfections in conformation appearing at the moment of development. The study of the anomalies of an organ compels, then, a perfect knowledge of its embryological development. Hence it is easily explained why the teratology of the dental system has remained so long unknown. It is, in fact, but a few years since the glorious discoveries of Kölliker, of Waldeyer in Germany, and those of Ch. Robin, Legros and Magitot, in France. These are the works which have established all our actual knowledge of the embryology of the teeth.

Guided by his personal studies, M. Magitot was, then, better qualified than any one else to conduct to a good end an enterprise which requires so much special knowledge and which necessitates such minute researches.

Applying to particular cases of dental conformation the designation which Isidore Geoffrey Saint-Hilaire has given to anomalies of organization in general, he calls all *deviation from the specific type* dental anomaly; that is to say, all infraction of the laws as a whole which determine the conditions of the dental system among individuals of the same species.

Comparative embryogeny and anatomy having permitted us to understand the interpretation which should be given to anomalies of an organ, showing them to us as phenomena of suspension, of complete stoppage, of unnatural enlargement, or of numerous disturbances in its development, it became necessary to glance at Morphology and the origin of the dental system. The author is thus led to look upon dental conformation in the animal series as derivant in all its forms from a primordial and unique type. This primitive type or *dental unity* which invests the conoidal aspect, is met with again in its simplicity among the lowest vertebrata, the fishes, which are known to be provided with a great number of teeth, all more or less conoidal.

It is upon this well-known principle that nature, always faithful to unity, is able to constitute so many varieties in the dental system, from the primordial form up to the aggregate and composite teeth, the human molars, for example, which are known to be formed from as many fundamental elements as they have cuspidated projections.

The modifications through which the dental system passes in the ascending scale do not always follow rigorously in their perfection the natural succession of the zoological orders.

However, it may be said in a general way, that as one advances upwards with the animal series, the dental organ departs from its primitive type. And, while decreasing in number, the teeth take more complex forms.

These anatomical considerations of the highest interest once established, M. Magitot studies comparatively, and always from a general point of view, dental anomalies in the series of mammalia. He shows us their essentially relative character. He points out by examples that a thing which may be perfectly normal in one species becomes abnormal in another; and that many anomalies are simply phenomena of return to a previous phase of existence followed by morphological mutations of the dental type.

Pursuing stil further, in man, these philosophical studies, the author is satisfied that the aforesaid phenomena explain certain deviations felt in the dental system and representing in the human species *constant anomalies* which take an ethnological character.

But certainly the most original point in M. Magitot's work is that which refers to the *teratogeny* proper of dental anomalies, which are divided, following the anatomical method, into nine classes: anomalies of *form*, *size*, *number*, *place*, *direction*, *dentition*, *nutrition*, *structure* and *arrangement*.

In the first rank of causes and laws which preside over the production of a great number of dental anomalies, hereditary tendency is placed. Hereditary transmission represents here, according to M. Magitot, a phenomenon of sexual selection which is able to maintain itself during several generations; but which is fated at last to disappear, in following succeeding sexual changes, and "the more surely in virtue of the law of return to the normal type."

Not being able to follow the author in the teratogenical study of each anomaly, we will limit ourselves, upon this subject, to touching a few of the most interesting points.

The mode of production of anomalies of *number* is well understood. It is known that the epithelial ridge, besides the germ destined to become a normal tooth, emits along its course secondary traces of germs which are ultimately absorbed. The abnormal development of one of these last explains the anomaly by numerical augmentation, just as atrophy or the destruction of the former accounts for the total absence of a tooth. As a reason for the deviations in place, M. Magitot assigns the simple displacement of a tooth upon the jaw or in the neighborhood of the epithelial ridge, and the following *migration* of the follicle. Heterotopia, far from the jaws, leads him to discuss the highest points of teratogeny: the theories of inclusion, diplogenesis, introrsion, and hetoroplasia. It would be, according to him, to the detriment of the epithelium produced by a blastodermic introrsion, if a tooth were developed in any part of the body, and without any connection with the normal dental system. That, if the epithelial tissue be absolutely wanting on the point where has been developed the abnormal production, it is because the follicle has separated itself by migration from a neighboring epithelial bed.

Apropos of anomalies of structure, the author raises a very interesting question, that of the *erosion* of permanent teeth, congenital alterations under the form of furrows, fissures, etc., often considered, and altogether wrongly, as a pathognomonic sign of certain diotheses – hereditary syphilis, for example. He thinks that *dental erosion* "is the indelible and permanent trace of an infantile disease of sudden invasion, and especially epileptic convulsion." If this idea, based upon a certain number of facts, but yet, meanwhile, contested, should be verified, erosion would be able to give confirmation to the hypothesis, advanced by Broca, that the pre-historical operations of trepanning were performed on infants afflicted with convulsions "in a mystical or religious idea that opening the skull would permit the escape of an evil spirit."

All that we have so far examined of M. Magitot's work belongs to teratology proper. We have dwelt so long upon this point because it constitutes, in our opinion, the essentially original and particularly interesting side of the book. That is not in the least to say that the chapters devoted to the particular study of many sorts of anomalies are of little interest. For, in addition to most minute descriptions of types so numerous and varied, the author has been able to introduce such pathological, and, above all, therapeutical considerations, as give them, besides the philosophical point of view, a truly practical and surgical character.

M. Magitot's book recommends itself, then, by its solid work, and should be read by the physiologist as well as by the surgeon. Let us add that the editor has taken great care to give the book a presentable form, the type being very clear, and the illustrations well executed.

Surgical and Medical Selections.

BONE-FORMATION AFTER RESECTION OF THE LOWER JAW.

BY B. V. LANGENBECK.

Gentlemen: I am permitted to make this brief communication through the (as I may well say) exceedingly great attention which Professor J. R. Wood, of New York, has shown, in sending this preparation here from New York by his assistant, Dr. Wiggin, in order to allow it to be demonstrated. Dr. Wiggin must return again to-morrow to New York, and, although our allotted time is very brief, nevertheless I have deemed it necessary to present this demonstration, because otherwise our distinguished American colleague would have sent us this really grand work in vain.

Prof. Wood, Surgeon to Bellevue Hospital, in New York, had the kindness to send me the photograph of this skull last fall—a skull of which the entire under jaw has been extirpated on account of phosphorus-necrosis, and of which the whole lower jaw has, in the course of a brief time, formed itself anew; and when, in my surgical lecture, I had shown and explained this photograph, *I did not believe that a corresponding preparation really existed anywhere*, he had the courtesy to send us this skull with the newly-formed lower jaw. I will quite briefly present the history of the operation, which is described in a short article by Dr. Wood in the "New York Journal of Medicine" for May, 1856, as the "Removal of the Entire Lower Jaw, for Necrosis caused by Phosphoric-Acid Gas."

A girl—Cornelia S.—sixteen years of age, formerly always healthy, had worked in match-factories, one of which was very badly ventilated, for two years and a half. She was occupied eight hours daily in packing matches, but enjoyed the best of health until May, 1855. At that time there took place, along with toothache, a swelling of the lower jaw, with suppuration. The patient, however, continued her work up to December, 1855.

Upon her reception into Bellevue Hospital, total necrosis of the right, and partial of the left, lower jaw existed, with profuse suppuration. The pus poured for the greater part into the cavity of the mouth, and outward through a fistula opening in the lower border of the mandibula. Notwithstanding this, her general health had remained good, and her appetite good, only chewing was very much impeded.

On the 19th of January, 1856, Dr. Wood made a resection of a part of the right lower half of the jaw, with most careful saving of the periosteum, and with preservation of the chin portion of the lower jaw. Healing resulted without interruption, but it soon became evident that the entire remaining under jaw was diseased also, and this had likewise to be removed on the 16th of February, 28 days after the first operation. Excepting the retraction of the tongue ensuing upon the removal of the jaw, and the choking symptoms induced thereby, the good effect of the operation and the healing of the wound remained uninterrupted, and in March, 1856, the patient was able to be discharged, recovered.

The reformation of bone was *complete*, and the function of the new lower jaw left nothing further to be desired. In the photograph taken at this time you observe the admirable contour of the lower jaw, of which the chin-portion only recedes slightly. Some years later, Cornelia S. died of abscess of the brain, and so Dr. Wood acquired the possession of this skull, which stands before you, and upon which you observe the entire lower jaw, with extremely complete form, only a very little smaller than the original must have been.

Formerly, cases of phosphorus-necrosis came into the clinic here not infrequently, and scarcely a term passed in which some jaw-resections were not performed. Thanks to the better ventilation in factories since 1864, scarcely any cases have come under observation, and it appears that phosphorus-necrosis will, at no very distant time, be eliminated.

I have performed subperiosteal resection of the entire lower jaw six times—four times in consequence of phosphorus-necrosis, and twice in consequence of acute osteo-periostitis. In all these cases reformation of new bones was observed, and, indeed, as in the case operated upon by Dr. Wood, with most complete restoration of the function.

When one extirpates the entire lower jaw from under the periosteum at one sitting, the chin must invariably recede. The room for the formation of the new lower jaw is restricted by muscles, namely, by the genio-glossi; the contour of the new lower jaw develops imperfectly, and the chin-portion of it retreats more or less perceptibly. In order to obviate this evil, I have, like Dr. Wood, made the operation at *two different times*, and at first cut out from the periosteum the smaller portion of the mandibula—which was, however, most diseased—leaving the chin and larger portion alone, and then, after four or six weeks, resected the remainder. But even then, as this photograph and the description given by Dr. Wood indicate, the lower jaw is always smaller, and the normal prominence of the chin is lacking.

This evil is almost completely avoided, if, as Billroth has recommended, one leave behind in position asteophytes from the necrosed bone, in immediate contact with the periosteum. This photograph shows you such a case. I cut out first the smaller part of the necrosed jaw-bone, and, after new bone could be distinctly felt—six weeks later—I cut out the greater part, with the chin portion. The resected jaw here shows you that osteophytes were left almost completely around. The photograph, which is taken in half profile (August Matthe's), shows you that the contour of the lower jaw is very complete, and that the chin stands out in the normal manner.

The skull sent to us by Dr. Wood settles at once the question of the durability of the new-formed bone. It has, indeed, been repeatedly maintained that the newly-formed bone, after subperiosteal resection, cannot be of a durable kind, but that it subsequently must be re-absorbed. At all events, this may happen, and I have myself seen it in the case of a woman suffering from phosphor-necrosis of the lower jaw, much reduced by long suppuration, whose lower jaw, newly-formed after resection, was, after a twelvemonth, almost entirely re-absorbed. Such an absorption of bone is, however, a rare occurrence in my observation, and I can testify to the unchanged persistence after years of the new bone-formation, after subperiosteal extirpation, as well in the lower jaw as in long bones (tibia, radius, os metacarpi pollicis).

Dr. Wood's patient died some years after the operation, and yet you see the new lower jaw preserved in all its parts, although a trifle smaller than was the original jaw.—*New York Medical Journal.*

THE DEVELOPMENT OF THE RED BLOOD-CORPUSCLES.

The development of red blood-corpuscles is a problem of profound practical importance, and every fresh information on the subject is to be eagerly welcomed. An interesting series of investigations by M. G. Hayem was recently communicated to the Académie des Sciences by M. Vulpian. They relate to the development of the red globules in oviparous vertebrata—birds, reptiles, batrachians and fishes. The blood of these creatures, according to these researches, constantly contains cells which are destitute of coloring matter, and yet differ essentially from the ordinary white corpuscles. These cells on development become perfect red corpuscles, and hence Hayem proposes to call them "hæmatoblasts." He has found them in all the oviparous vertebrata examined (various birds, the tortoise, lizard, adder, frog, toad, triton, axolotl, and several fishes). They are also found in the blood of the tadpole, in which the characters they present are the same as in the adult animal. During their successive transformations the hæmatoblasts pass through two phases. They are at first very pale and delicate, so that it is with difficulty that they can be distinguished from white corpuscles They differ from the latter in the transparency and feeble refracting power of their protoplasm, and by their viscosity, by which they adhere one to another, and sometimes form a mass of considerable size. Their form is, moreover, somewhat angular or elongated, especially in birds, and they have a solitary nucleus, which is clearer than the body of the corpuscle. The characters of the nucleus vary in different animals, but always resemble those of the nuclei of the red corpuscles, with this difference, that the latter are a little smaller, and often less elongated. In the second phase of development the corpuscles gradually assume the appearance of small discs, and lose their viscosity. Their aspect now, which is nearly the same in different animals, was described last summer by M. Vulpian. The tint of the hæmatoblast is a little darker than that of the original cell, and the nucleus occasions a prominence on each side of the disc. In the forms which are a little more developed, the protoplasm is reduced to a narrow ring around the nucleus, and the corpuscle assumes a shape resembling that of the developed red corpuscle, now and then first assuming an irregular shape. Sometimes the disc is composed of two distinct parts, as M. Vulpian has shown, a central clear and slightly granular portion forming a zone around the nucleus (of this traces may often be seen in the adult corpuscle), and another peripheral zone more homogeneous, and soon to become impregnated with hæmoglobin. The coloring matter appears usually before the development of the cell is completed, and then some colored elements may be seen in the blood, having the form of hæmatoblasts. Their size varies according to the stage of their development; that of the nucleus varies according to the size of the nuclei of the red corpuscles in the same animal. Examined in a damp chamber, the hæmatoblasts are seen to undergo slow changes of shape, but these are believed by M. Hayem not to be true amœboid movements, but rather to resemble the successive stages of cadaveric destruction. After some hours the hæmatoblasts which were in the first stage of development are represented only by their nuclei retaining still some irregular tracts of a finely granular material; those which had attained the second stage are in general more resistant. All the reagents act on the hæmatoblasts just as they do on the red corpuscles, and produce no effects such as are manifested by the leucocytes. When dried rapidly, many small cells, which were colorless in the wet state, appear to be colored, as if they already contained a small quantity of hæmoglobin. A comparison of the blood of many animals shows that these hæmatoblasts are in no case less numerous than the leucocytes, and that often, on the contrary, they are twice as numerous. Their proportion to the colored corpuscles is, in the bird, 1 to 100, in the snake 1 to 40, in the tortoise 1 to 50, and in frogs 1 to 60. Hayem concludes that the white corpuscles do not form the red globules, and that while in the higher animals the newly-formed red corpuscles are colored, whatever their origin, in the ovipara the embryonal corpuscles are at first free from hæmoglobin. An important problem is the relation these so-called hæmatoblasts bear to the leucocytes: whether they are really distinct, or merely a stage of transformation of the latter. This point, in spite of M. Hayem's opinion, must be considered as still doubtful.—*The Lancet.*

THYMOL, THE NEW ANTISEPTIC.

A rival to carbolic acid has certainly been discovered in thymol, the essential ingredient of the oil of thyme, which is prepared either by treating the oil of thyme itself with a strong alkaline solution, skimming off the thymene and cymol, which separate and rise to the surface, and precipitating the thymol which remains in solution with hydrochloric acid; or else (and this appears to be its most common commercial source at present) by distilling the seeds of *Ptychotis ajowan*—an East Indian umbellifer, which contain from 5 to 6 per cent. of their weight of this body. Thymol was discovered, according to Lewin, in 1719, by Caspar Neumann. Its chemical properties were first examined in detail by Leonard Doveri and by Lallemand; and its anti-putrescent properties were first distinctly pointed out by Bouillon and Paquet, of Lille, in 1868, though they only used it to deodorize unhealthy wounds, and did not attribute any antiseptic properties to it in the present surgical sense of the word. These properties were first definitely recognized, in 1875, by Dr. L. Lewin, of Berlin (*Centralblatt Med.*

Wiss., No. 21, 1875, and *Virchow's Archiv*, Band lxv., s. 165), and by Husemann and Valverde (*Archiv für Exper. Path.*, Band iv.). Lewin, who worked in Professor Liebreich's laboratory, showed experimentally that solutions containing one part thymol per 1000 absolutely arrested saccharine fermentation; and that they powerfully retarded lactic fermentation, and checked various processes of decomposition, even when used in relatively small quantities. Lewin also first pointed out the comparative harmlessness of thymol internally administered; the absence of digestive disturbance after taking it, and its effect in checking abnormal fermentation in the stomach. He further directed public attention to the probable future of the drug as an antiseptic. Husemann's experiments, which were chiefly made on rabbits and frogs, went to show that thymol is *ten* times less poisonous to the organism than carbolic acid, and that hence in the quantities ordinarily used for antiseptic purposes it may be considered as entirely innocuous. He further showed that thymol is a far more powerful antiseptic than carbolic acid, that its local application to the skin, either as such or in saturated solutions, had no irritant effect whatever, and that in animals poisoned by excessive doses gastric erosions never occurred as they do in carbolic acid poisoning, but that, on the other hand, nephritis with albuminous urine and extensive fatty degeneration of the liver are nearly constant phenomena in these cases.

At present it is as an external antiseptic that thymol claims the earnest attention of the followers of Lister. The success which has attended its introduction into Professor Volkmann's clinic at Halle, as described by his assistant, Dr. HANS RANKE, in No. 128 of *Volkmann's Sammlung Klinischer Vortrage*,* is striking in the extreme, and we propose here to bring before our readers the method employed and the results obtained. In the main the general features of Lister's antiseptic dressing were retained by Ranke, thymol being substituted for carbolic acid, with the single exception of the ligatures used for arresting hemorrhage and deep sutures, which were always made with carbolized catgut. Since thymol is not entirely soluble in water in the proportion of 1 to 1000, the following formula was, after the first few trials, exclusively used for antiseptic purposes: Thymol, 1 gramme; alcohol, 10; glycerine, 20; water, 1000 grammes. This "thymol solution," as it may be called for brevity's sake, has no corrosive action on instruments immersed in it, and in this respect is superior to solutions of carbolic, and still more of salicylic acid. It causes, however, when sprayed over the hands of the operator, a lively sensation of burning, accompanied with redness of the skin; but otherwise has no irritant qualities. Anæsthesia of the skin and epidermic desquamation, both of which are liable to occur under the use of carbolic acid, were never once observed in the case of thymol, nor did it exert any irritant action on the respiratory organs. The gauze bandages used for Lister's dressing were composed of the following materials: 1000 parts of bleached gauze, 500 of spermaceti, 50 of resin, and 16 of thymol, spermaceti being substituted for paraffin as a non-irritant, its object, however, being the same—namely, to retard the evaporation of the somewhat volatile thymol. In these proportions the gauze is extremely soft and pliant; it can be accurately adapted to the wound, and "sucks up" (to use Dr. Ranke's own expression) "blood and the secretions of the wound like a sponge." Owing to the impregnation of its fibres with spermaceti and resin, they are unable to absorb the fluid, and, as the latter distributes itself only in the meshes of the tissue, the bandage retains its elasticity in a high degree, even when thoroughly soaked. This thymol-gauze was directly applied to the wound, no "protective" being necessary, owing to the non-irritant quality of the thymol. Between the seventh and eighth external layers a piece of gutta-percha paper, previously washed with thymol solution, was inserted in place of the ordinary hat-lining, and the whole was firmly fixed to the body with a gauze roller soaked in thymol solution, and tightly drawn, so as to seal up the parts almost hermetically against the outer air. Under these conditions very little thymol evaporates, and even at the end of eight days a very strong smell of thyme is perceived on removing the bandage. The thymol-gauze should be kept in stock wrapped in parchment paper, which should only be opened at the moment of using. The bandage must be removed and renewed as often as the least trace of secretion reaches its surface; but this necessity arises very much less frequently than in the case of Lister's carbolic dressing. In no instance, however, was the same dressing allowed to remain unchanged more than eight days. On those parts of the body to which it was difficult to adapt the dressing, the edges of the bandage and any other apparently weak points were strengthened with strips of benzoic wool.

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* "Ueber das Thymol und seine Benutzung bei der antiseptischen Behandlung der Wunden."

On the whole, from the summer of 1877 up to January 23, excluding a number of slight injuries and trifling operations, thymol had been used in fifty-nine operations in Volkmann's clinic with the most excellent results. In the first forty-one cases the secretion was serous in only eight, and purulent in two. In the remainder there was absolutely no secretion—that is to say, when the bandage was removed the skin of the protected parts was found completely dry, and not a drop of liquid could be squeezed out of the layers of gauze. This first series of thymol dressing includes cases of amputation of the mamma, of the arm, of the foot, by Chopart and Pirogoff's operations, three amputations of the leg, four excisions of the elbow, two radical operations for hernia, and seven radical operations for the cure of hydrocele by excision. The sixteen severe operations treated with thymol during January of the present year include, *inter alia*, a gunshot wound of the knee-joint treated by drainage of the joint, a secondary amputation of the thigh, an incision of the hip, and also one of the knee-joint for scrofulous caries, and an excision of the shoulder in an old case of dislocation of the humerus complicated with fracture, in all of which the results obtained were equal to those of the first series. Lastly we should mention the successful termination of three ovariotomies performed by Professor Olshausen, and treated throughout on antiseptic principles by means of thymol dressings.

To sum up Dr. Ranke's observations on the use of thymol, we may say that nearly all the major operations of surgery have been treated by him successfully by the thymol modification of Lister's method; and although at present the introduction of thymol offers no hope of any relaxation of the minute attention to details which a successful carrying out of this method invariably necessitates, yet since the secretion of wounds treated by thymol is much less, and their rate of healing much quicker, than when carbolic acid is used, thymol deserves the preference over the latter, the results obtained with it (antiseptically considered) being, to say the least, equally good. An additional advantage of thymol over carbolic acid consists in its innocuous effects on the system at large, and in its non-irritant action on parts to which it is locally applied. Thus, on the one hand, permanent antiseptic irrigations with thymol solution (1 per 1000), which cannot be carried out with carbolic acid for any length of time, have been repeatedly and successfully used in Professor Volkmann's clinic; and, on the other, the redness of the skin, vesication, and eczema produced by carbolic acid dressings have entirely disappeared on the substitution of thymol for it.

At present one kilogramme of thymol costs, in the German market, sixty marks (£3), whereas carbolic acid costs a little more than three shillings per kilogramme, so that, at first sight, the expense of thymol dressing appears to be very great. If, however, as Dr. Ranke clearly shows, we take into account the reduction in the number of bandages rendered possible by the use of thymol, owing to the extremely small amount of secretion induced by the new antiseptic, the difference in price is much more than compensated for. Thus, to give a single example of the superiority of thymol, we may mention the fact that two cases of diffused ganglion of the palm, treated by incision, required only two changes of bandages instead of eight or ten, as they would under the ordinary Lister's treatment.

The internal use of thymol in various diseases has at present scarcely answered to the expectations which were formed of it. Experimented with on a large scale by Coghen, of Cracow, it only relived the symptoms in a case of chronic gastric catarrh accompanied with fermentation; whereas, in a number of cases of acute and chronic gastric and intestinal catarrh, in intermittent fever, chronic cystitis, typhoid fever, pneumonia, pulmonary phthisis, and chronic bronchitis, it completely failed. As an antipyretic, in doses of two to four grammes (Baelz), its action is also far inferior to that of salicylic acid; hence, for the present, at any rate, it is for its valuable antiseptic properties that thymol deserves to be attentively studied; and there can be no doubt that Dr. Ranke's experience offers every encouragement to antiseptic surgeons to introduce it largely into their practice.—*Med. Times and Gazette.*

TREATMENT OF STOMATITIS MATERNA.

BY E. P. HURD, M.D., NEWBURYPORT, MASS.

The pathology of this affection, which is sufficiently common in the experience of general practitioners, is obscure; is seen in patients who seem to be well in other respects; is generally an index of lowered vitality; sometimes an inflammation, the result of local nutritive disturbances of reflex origin, the irritation being mammary. In the ptyalism of pregnancy we see an instance of the same etiological kind.

Stomatitis materna takes the form of acute or chronic oral catarrh, also aphthous and ulcerative stomatitis.

It is sometimes very obstinate and intractable. Weaning the child always brings about a speedy cure. It is, however, generally amenable to treatment of a simple nature. Where, from lowered vitality, a tonic regimen, as quinine, porter, iron, and cod-liver oil is required, there are two preparations of the latter in the market which I find almost equally serviceable—Scott's Emulsion and Phillips'. Many, however, can take Phillips' oil that cannot take Scott's. Phillips' oil is borne by the most delicate stomachs. I consider this preparation invaluable for nursing-women whose nutrition is below par.

Nursing sore-mouths will often yield to astringent gargles, or mouth washes. Chlorate of potash is good in this affection, as in all other oral affections of an inflammatory and ulcerative nature.

The glycerite of tannin, a great favorite of Ringer in all these complaints (see his *Handbook of Therapeutics*, page 300), is sometimes all the application that is needed —to be brushed over the parts affected twice or three times a day. Where astringents alone will cure, this will cure.

The sulphites, especially the sulphite of sodium, the sulpho-carbolate of sodium, are recommended. The sulphite of sodium may be given internally in doses of a scruple three times a day, and also used as a mouth-wash.—The same dose (℈i.) may be given of the sulpho-carbolate of sodium, and, dissolved in an ounce of water, used as a gargle. These medicines undoubtedly have an alterative effect, as well as a local action. (See Braithwaite, Part 63, page 24).

The tincture of smartweed (*polygonum punctatum*) in drachm doses, diluted with water) to be taken internally, and used as a gargle, is highly recommended by a writer in the *Philadelphia Medical and Surgical Reporter*. Another authority regards bismuth, in ten-grain doses, as a certain remedy.

In several obstinate cases I have used the following formula with good results. (The formula is borrowed from the *Reporter*.) In one case cure followed in less than a week, but during its use the baby, previously well, was severely griped and purged. I think that it should be used with much caution, and discontinued in a few days if it does not seem to do good, or if it affects the baby injuriously. The dose of the biniodide is about one-thirtieth of a grain:

R. Hydrarg. biniod	gr. v.
Pot. iod	gr. x.
Aquæ	℥ j.

M. Ft. sol. liq.

Take three to five drops, ter die, after meals. For a mouth-wash, add six drops to a tablespoonful of water.

This remedy, besides its local stimulant and resolvent action, undoubtedly does good as an alterative, improving local and general nutrition.—*Medical Record.*

Items.

INTRAOSSEOUS EPULIS.—Dr. L. A. STIMSON presented a bony tumor of the upper jaw, with the following history: A woman, aged forty, entered the Presbyterian Hospital February 13, 1878, having a tumor of the upper jaw, to the left of the median line. This made its appearance eleven weeks previously as a small lump on the gum, which grew rapidly, and was at times painful. The patient had, with the exception of the first and second molars, only the canine tooth on that side; and eight weeks after the tumor made its appearance the canine tooth was removed. This was followed by severe hemorrhage, which at intervals recurred. When the tumor was examined it was found to be above the margin of the upper lip, and sufficiently large to obliterate the canine fossa. It was globular in form, and extended from the median line to the first molar. The surface was smooth, and of a dark-red color. The tumor was firm and could not be reduced by pressure, and was painful only at its upper border. There were no enlarged glands in the neighborhood. It was decided to remove the growth, and for this purpose an incision was made by the side of the nose, extending downward around the ala to the median line, and then directly down through the lip. The flap was dissected up, and the dissection continued outward as far as the molar process of the superior maxilla. The bone was cut through in the median line, across the antrum from the nasal fossæ, and from the extremity of the latter incision directly downward to the second molar tooth. The bone was then bent upward, fracturing the palatal processes, and, after division of the mucous membrane of the palate, was removed. The posterior palatine artery was tied, and the bleeding from other vessels arrested by torsion and the actual cautery. The flap was then secured by sutures, and union by first intention occurred along the whole of the cutaneous incision. Section of the tumor showed it to be red and dry, with fibrous bands crossing it vertically. A microscopical examination showed the presence of fibrous tissue, numerous vessels, and giant cells. The tumor seemed to have its origin in the bone, and was of the class myeloplaxoma, and benignant in character. The points of diagnosis were the dark-red color, the location in the spongy part of the bone, and the absence of glandular enlargement and of pain.—*New York Medical Journal.*

TREATMENT OF BOILS.—As the result of physiological experiments, Dr. Planat (*Lyon Médical*) has been led to the use of arnica in all cases of superficial acute inflammation, as furuncles, anginas, erysipelas, etc. He states that arnica aborts all furuncular eruptions, except those accompanied by diabetes, with remarkable promptness. For external use he employs: *Recipe.*—Extract of fresh arnica flowers, 10 parts; honey, 20 parts. If this is too liquid, he adds lycopodium. The mixture is applied to the inflamed part, and covered with oil-silk. Equally good results will be obtained in the same way by the internal administration of tincture of arnica in doses of twenty-five to thirty drops every two hours. M. Planat adds that the extinction of the furuncular eruption is so rapid that it seems impossible to deny a specific elective action.—*Med. Press and Circular.*

PREVENTION OF POISONING WITH ARSENIC.—We gather from the Spanish journal *Revista di Medicina y Cirurgia Practicas* (7th January, 1878) that M. Jeannel, of Paris, has lately given a lecture, in which he proposes that chemists should sell arsenic to the public only when so combined that it immediately attracts attention when added either by accident or design to food. The plan has not been overlooked, for there is an officinal mixture in which the arsenic is combined with peroxide of iron and a small quantity of aloes, but it is not sufficiently characteristic, and he calls attention to a mixture termed Grimaud's mixture. This consists of one centigramme of iron sulphate and one of potassium cyanide to each gramme of arsenious acid, forming a light-blue powder. On being moistened, however slightly, it becomes of a rich blue color, whilst the taste is so distinctly chalybeate that it is impossible to overlook its presence in any article of food. It has the advantage of not altering or interfering in any way with the therapeutic properties of the arsenic.—*The Lancet.*

THE STRUCTURE OF TACTILE CORPUSCLES.—M. Ranvier has lately presented to the Académie de Médecine a note upon the termination of the nerves in tactile corpuscles. It has hitherto been believed that the nerves enter the terminal cells and present swellings at their entrance, and that touch acts directly on these cells. M. Ranvier believes that this termination is not real. By staining the ultimate nervous ramifications black by means of certain salts of gold, he has observed the nerve filaments to end between two cells, and not to penetrate the cells. There is no continuity between the cells and the nerves. The office of the cells is simply that of protection of the nerves or of intensification of the tactile vibrations. This is a subject for further study. The observations have been made on the tactile corpuscles of the duck's beak.—*The Lancet.*

THERMO-CAUTERY AND ETHER.—When employing thermo-cautery, chloroform should be used as the anæsthetic instead of ether, the latter being liable to ignition and explosion.—*Medical Record.*

A Wisconsin dentist recently received the following from a patient writing for advice: "My mouth is three inches across, five-eighths inches through the jaw. Sum humoky on the edge. Shaped like a horseshew, toe forrard. If you want me to be more partikler I shall have to cum thar."

Obituary.

CHARLES A. DU BOUCHET, M.D., D.D.S.—Died March 12th, 1878, at his residence, Rue de la Faisanderie 27, Passy, Paris, aged fifty-nine years.

Dr. Du Bouchet was for a long time one of the most prominent members of the dental profession in this country. He was of the founders of the first chartered Dental School of Philadelphia, was a member of the Odontological Society of New York, of the Odontographic Society of Philadelphia, and of various other dental and benevolent societies in this country and Europe. He was also Chevalier of the Order of Isabel the Catholic. For the past eleven years he resided at Paris, where he enjoyed the practice and confidence of a large clientèle.

RESOLUTIONS RELATIVE TO THE DEATH OF DR. DU BOUCHET.

At a meeting of the Odontological Society of New York, June 18th, 1878, a committee was appointed to draft resolutions expressing the feeling of the Society upon the reception of the news of the death of Dr. Charles A. Du Bouchet. The committee, therefore, presents the following:

Whereas, We have heard with deep regret the sad tidings of the death of our esteemed Associate Member, Charles A. Du Bouchet, M.D., D.D.S., of Paris, France; therefore,

Resolved, That the New York Odontological Society shares, in common with the various other bodies of which Dr. Du Bouchet was an honored member, in the profound sorrow which the loss of such an able and upright man must ever occasion—a loss not alone to the profession which he adorned, but still more to the community at large.

Resolved, That as a token of our respect for his memory, we set apart and inscribe with these proceedings a separate page in the record of the minutes of this Society, and that the Secretary be directed to address a copy of these resolutions to the family of the deceased, with the assurance of our profound sympathy in their affliction.

A. H. BROCKWAY,
C. E. FRANCIS, } *Committee.*
A. C. HAWES,

NON-TIPPING

GOLD BLOCKS.

We have just succeeded in making a block, very cohesive,

SOFT UNDER THE INSTRUMENT,

And almost entirely free from the tendency to tip and curl up, which is so annoying.

They will be made in the same sizes as the Rectangular Gold Pellets and Corrugated Gold Blocks.

Small quantities can be supplied at once.

R. S. WILLIAMS.

Dental and Oral Science Magazine

No. 4. NOVEMBER, 1878. Vol. 1.

New York Odontological Society.

Regular Meeting, October 15th, 1878.

The meeting was called to order at 8 P. M., the President, Dr. Lord, in the chair.

INCIDENTS OF PRACTICE.

Dr. C. E. Francis (*New York*): To-day I heard of a case in which the two central inferior incisors were erupted at birth. The physician had the teeth removed, giving as his reason that the child could not nurse with them. I would like to ask the opinion of this meeting as to whether it is good practice to remove such teeth. Would any bad effects be likely to result?

Dr. Wm. H. Atkinson (*New York*): The teeth should be removed if they hurt the mother's nipples. The temporary teeth, and especially those erupted at birth, are not enclosed in a bony sac, and do not interfere with the coming of the permanent teeth.

I would like to state a point in the bleaching of teeth. After removing the discolored dentine as far as possible, fill the tooth with pulverized alum, into which inject Labarraque's solution of chloride of sodium. Chlorine will be at once developed, and act directly, from its position in the tooth: and a tooth may be thus bleached at one sitting. The application may last from one minute to three hours, repeating if necessary.

Mr. Dexter (*New York*): Would there be sufficient chlorine developed to injure the soft tissues?

Dr. Atkinson: No, sir. The chlorine, in this method, acts while in its nascent condition, when it is most powerful as a bleaching agent.

Dr. George Allan (*New York*): I wish to ask Dr. Atkinson in what way the combination of alum and Labarraque's solution can liberate a larger volume of chlorine than would escape from the Labarraque's solution alone?

DR. ATKINSON: If you can have chloride of sodium holding an excess of chlorine *without* having chlorine, then you can do more than I. If you know the composition of Labarraque's solution, then you know the elements for the action are there.

DR. ALLAN: I think I asked a very simple question. Dr. Atkinson said that chlorine was liberated, and I asked how it happened. In the alum there is no chlorine, either free or in combination. It would, therefore, be impossible for the alum to liberate a larger amount of chlorine than would be set free without its presence. Labarraque's solution is simply chloride of soda holding in watery solution an excess of chlorine.

DR. ATKINSON: You assert that there is no chlorine there, either free or in combination.

DR. ALLAN: In the alum.

MR. DEXTER: Will Dr. Atkinson tell us what part the alum plays in liberating chlorine from Labarraque's solution?

DR. ATKINSON: It has a stronger affinity for the oxygen than the other elements (sulphate of alumina and potash) which enter into the triple salt which we call alum.

DR. ALLAN: I deny that alum is a triple salt. It is a double salt—a combination of sulphate of alumina and potash. It is impossible that it should have any direct action upon the chloride of soda. The alum is a stronger chemical combination than the soda, and the stronger combination would certainly not be decomposed by the weaker.

DR. ATKINSON: We must take into account the bond of affinity belonging to the atoms which form the molecule by the awakening and engagement of these bonds, in order to know what "strong" is. To deny that chlorine is in chloride of sodium is not chemistry; and to assert that there is a stronger or weaker affinity between atoms, we must understand what we mean by those terms. If the doctor means that there is a stronger affinity between the alum and the tooth than there is between one of the elements of that salt and the chlorine, then the dispute may be considered settled by the fact that the chlorine is set free. You can test it for yourselves.

DR. ALLAN: I do not recollect the amount of chloride of sodium in Labarraque's solution; but it is certain that the alum must have some chemical action upon the chloride of sodium in order to liberate a larger amount of chlorine than would be liberated if the Labarraque's solution were used alone. This, I assert, cannot happen. There can be no chemical action in the combination of alum and Labarraque's solution by which the alum will disengage more chlorine than would be set free were it absent.

Dr. Atkinson: I doubt if it is profitable to continue this. Try the experiment for yourselves, gentlemen.

Dr. C. Palmer (*New York*): I lately had a case in which the two superior incisors were largely wasted away, and which the patient desired to have repaired without having the gold show. The walls were thin, and would not permit the ordinary means of attaching enamel. I ground pieces of enamel so as to nearly fill the cavities, and then ground grooves around them and fixed them in place with Guillois' cement, the latter filling the grooves and holding the pieces in place. The result was very satisfactory.

Dr. W. C. Barrett (*Buffalo*): Every dentist is aware of the importance of tabulating his cases. I know of no book which offers proper conveniences for this, and therefore I have drawn up a form, of which I present proof-sheets to you. It will be published in book-form, very like the "Dental Register" now in use, and may be procured at the dental depots. Although the publisher has placed my name upon these, I do not claim any great originality or extraordinary merit for the plan. It is simply a convenience. If the gentlemen will offer any suggestions to increase the value of this form, I shall be glad to accept them. I think it of much importance that we should have some system of tabulation and record of our cases. Much good would certainly result.

Name and Residence.	Age.	Temperament.	Condition of Teeth.	Cases and Symptoms.	Date.	Diagnosis.	Treatment and Progress.	Remarks.

The following paper was then read by the author:

NEW PRINCIPLES IN DENTAL PATHOLOGY: A REVIEW OF THE SO-CALLED NEW DEPARTURE.

BY W. C. BARRETT, M.D.S., BUFFALO, N. Y.

At a meeting of this Society held about a year ago, a paper having for its title "*Plastic Fillings, and the Basal Principles of the New Departure*," was read. That essay has attracted attention in some quarters, but much the greater portion of the profession have chosen to ignore it altogether. I cannot commend this course; for, if there be any new and great principle involved in this doctrine, the matter is worthy of our most careful consideration; and if it be a compound of errors, others have a right to an expression of our opinion to that effect.

He who discards old-established usage, and proposes a complete reversal of methods long in vogue—who places himself in direct opposition to well-established and accepted authorities—ought previously to carefully consider the ground he proposes to occupy, and be sure of his premises before stating conclusions. Luther, Kepler, Harvey, Newton, proposed, in their times, "new departures"; but they were themselves authorities in the positions they overthrew, and thoroughly conversant with and expert in such principles. It is a grave matter, this attacking a world. It may be an indication of the most determined courage, or it may be but an exhibition of the veriest foolhardiness. The assailant may be a true reformer, or he may be only a mistaken enthusiast. It is therefore our duty to critically examine new doctrines; to shun that undue credulity which disseminates error, as well as to avoid that pride of opinion which would close our minds to new ideas, simply because of their novelty. In this spirit let us examine the subject of the new doctrines.

I object to the proposed "New Departure," and cannot give it my support, because I believe it to be a mere vagary of the mind—a fallacy which does not even rise to the dignity of a sophism.

To establish my right to thus sit in judgment upon this proposed new method of practice, I declare that I have studied the matter and patiently considered it; that I have instituted a system of experiments which I have observantly conducted during a period of more than four years; and that, the more closely I examine the matter, and the better I become acquainted with its basal principles, the more firmly is my faith in long-settled practice established.

To Dr. S. B. Palmer is due the full measure of credit for first presenting to the profession any theory concerning that which has since been modestly denominated the "New Departure." He is, you are aware, a *student*, according to the light given him. He is not a mere speculative theorist, searching for corroboration of a previously conceived hypothesis. On June 25th, 1874, Dr. Palmer read before the New York State Dental Society a paper entitled "Chemical and Galvanic Action upon the Teeth"; wherein was first (to my knowledge) broached the theory of galvano-electrical disintegration of the teeth. The paper was warmly received, and Dr. Palmer was urged to continue his investigations. At the meeting of the same Society, June, 1875, he read his paper entitled "Success or Failure in Dental Operations Chemically Considered;" and in July, 1876, another, called "Choice of Materials in Filling Teeth." These were his principal papers upon this subject. All were read before a Society in which I was vitally interested, and hence they especially challenged my attention. I immediately, after the hearing of his first paper, commenced a series of experiments to practically test the truth of his assertions, and have ever since been engaged in closely watching that which would be likely to prove instructive.

And now let me give my reasons for believing the "New Departure" a fallacy:

First.—It is, to my apprehension, an entire misconstruction of scientific law.

Briefly stated, the theory rests upon these hypotheses: That, in the presence of an acid, any two diverse substances form the elements of a battery; that one of these is at the positive pole, or assumes a positive relation to the other, and is therefore disintegrated; that different substances have widely differing electrical relations; and that upon these relations depends the amount of the disintegration, and which of the elements is acted upon and disintegrated.

Now, nothing can be stated against these hypotheses, *as such.* It is the interpretation given to them in which lies the mischief. The new-departurites confound *cause* with *effect.* The tooth, the filling, and the oral fluids, form the elements of a battery. But the electric current is wholly dependent upon the chemical action of the fluids which generate it; instance the zinc and copper cell. In the presence of the acid the zinc is positive, and is corroded by—what? By the *electric current?* Not at all; but by the chemical action of the acid which *generates* the current. Yet the new doctrines call upon us to believe that electricity, *per se,* is the destroying force.

It is an axiom among electricians, that there is no electric current without some preceding molecular change; that an electric current is but the effect of some producing cause. Yet here we see it elevated to a primal importance, and designated as the *cause of the cause*—a thing which has produced itself! To my apprehension, the galvano-electric current in the mouth is but the *effect* of tooth-decomposition through chemical changes in the mouth.

Second.—Any electric current which may be detected in the oral cavity is possibly due to other causes than the presence of the elements of a voltaic battery. There are constant thermal changes which are quite competent to deflect a delicate galvanometer. Before we alter our practice entirely, we desire to know that any possible current is traced to its proper cause.

Third.—An *electric* current may excite chemical action sufficient to decompose a compound, or even volatilize a simple substance; but a comparatively powerful current is required to do this. Most conductors are competent to carry away, without injury to themselves, all the electricity they are likely to receive. It is absurd to suppose it possible for any current to exist in the mouth, capable of decomposing tooth-tissue.

Fourth.—If a gold filling in a tooth is capable of developing a current sufficient to excite the disorganization of bone, what must be the effect of a partial gold plate in the mouth? It might readily be supposed (according to the new doctrines) to be as bad as a charge of dynamite.

Fifth.—If the presence of metals (which, according to this new gospel, assume a negative relation to the tooth) be the principal or only cause for decay of the teeth, then unfilled teeth ought never to decay, and there should be no necessity for filling teeth primarily, since one of the elements of the battery is then wanting, and, by consequence, there can then be no tooth-disintegration. But, since this is not, in reality, the case, why may we not say that the same conditions which produce decay before filling, do so afterward?

Sixth.—In the consideration of any of the phenomena of Nature, we never need search for a recondite cause so long as ample reasons lie near the surface, or in full view. A very sufficient excuse for the disintegration of teeth after filling may be found in imperfect manipulation, and direct chemical action, without appealing to electrolysis.

Seventh.—In any case, an electric current is but one of the factors in the sum of tooth-decay, whereas, by the terms of this new doctrine, it is elevated to the importance of being the only cause worth taking into account (see Articles II and III of the "New Departure").

Eighth.—I consider this new theory fraught with evil to the dental profession, because young dentists are, in effect, taught by it that the years of patient, steady, persistent effort to reach a higher plane of excellence are thrown away, and that the unskilled recruit is fully the equal of the old veteran; that experience goes for nothing, and that firmly established principles may be swept away by a single blast from a discordant trumpet. If there be no necessity for thorough excavation, as has been urged by the apostles of this new-fangled theory—if a leaky filling is better than a tight one (see Article VI, New Departure)—and if the easily manipulated plastic fillings are superior to thoroughly impacted gold ones—then the time, practice and patient study necessary to learn the proper manipulation of gold foil are worse than thrown away, and those who have spent so many years in accumulating practical knowledge, are the inferiors of the boys just commencing their career. Then, at the outset of my practice, when my ability did not extend beyond the inserting of amalgam into improperly excavated, wet cavities, I was a better operator than I now am, after fifteen or twenty years of constant deterioration in the line of gold practice!

Ninth.—The return to plastic fillings is the adoption of a practice which has been proven to be inferior. American dentistry is known and honored among all civilized peoples, and American dentists are conceded to be without foreign peers. Yet European dentistry differs from ours only in the materials used, and the consequent manipulative ability. Gold has been the mainstay of the American dentist, and the possibilities of this material have stimulated him to the highest attainments in manipulative skill. The European dentist has used, mainly, plastic fillings, and his progression in dentistry has barely kept place with the possibilities of his material. The abandonment of gold means the forsaking of the metal which has made the American dentist what he is, and the adoption of that material which has made the European dentist his inferior.

Tenth.—The proposed "New Departure" in dentistry rests upon a hypothesis toward the proving of which not one element of satisfactory evidence has been advanced. When Darwin, Tyndall, or other scientists, propose any new doctrine, it is the result of a long and exhaustive series of experiments, either performed in the presence of unprejudiced spectators, or the most minute details of which are carefully set down. Upon what extended series of experiments does this new theory rest? Dr. Palmer, in his paper entitled, "Chemical and Galvanic Action upon the Teeth," gives a brief account of a very few. He says: "We take teeth and pound them in a clean wedgewood mortar, somewhat fine, and connect the pieces with the gold, using dilute sulphuric acid, and we find tooth-bone an electrolyte, or positive: the gold will remain a negative. Between the tooth and the gold the action of the needle will be slight; between tin and gold, very great. * * * The next test is between tooth-bone and tin foil." Now, it seems to me that such experiments as these amount simply to nothing, in determining the points in question. In the first place, the conditions are not at all those found in the oral cavity. We do not question his very indefinite and inexact declaration, that "the greater the difference between two elements, the stronger the current;" but in what way does this prove that chemical disorganization of tooth-tissue is due to a galvanic current which this same chemical action develops? Tooth-bone, treated with sulphuric acid, may develop a current in the production of the resultant sulphate of lime; but we should not call this salt, so produced, the result of an electrical condition. If we are to abandon our present practice for a new theory, we desire to know exactly what experiments and proofs substantiate the hypothesis. We demand that trial tests be performed, either in our presence, or substantiated by such minuteness of detail as shall give others an opportunity to verify or disprove them. We want to know just what were the conditions of the tests. If it is stated that the galvanometer needle was deflected, we wish to know *what* galvanometer, and how it was used; for these instruments are not only very differently constructed and manipulated, but those of a kind vary greatly in results from each other. We ask what unit of resistance was used in the calculations; how the current was measured or shown; if measured, the number of ohms; if shown, whether it was by the galvanometer, the electrometer, by chemical action, by thermal effects, by induction, or "by guess." In short, we ask for *facts*, not speculations. Scientific men are not in the habit of accepting the crude ratiocinations of possibly interested men, in matters where carefully conducted experiments may practically solve the question.

If an active acid is used, letting go its hydrogen it unites with a base to form a salt, at the same time, and by this action, generating an electric condition. Hence, it is absurd to charge, *as the cause* of this action, one of its accompanying phenomena—the result of a chemical action which would generate a current without the presence of any metal. Again, if the elements be subjected to thermal changes, as in the oral cavity, a current may be developed without the aid even of an acid; for instance, warm a piece of platinum, place it in simple contact with gold, and a current is at once developed. Or, put a piece of zinc wire in proper contact with that of a Thompson galvanometer, then *twist* the wire, and your instrument will indicate the presence of an electric current. In fact, electrical conditions are produced by all molecular change, but such currents will not decompose tooth-tissue.

In view of these facts, I dispute the conclusions advanced by the new doctrine. I say that the so-called "New Departure" contravenes the fundamental principles of physics. It contradicts all science and all scientific men. It is utterly unworthy of even our respect, until it be established by experiments in the mouth, conclusive, and often repeated, under all possible circumstances. Generalizations will not be sufficient, when it is sought by them to establish scientific truth.

But what are the conceded facts concerning this whole matter? In the February number of the DENTAL AND ORAL SCIENCE MAGAZINE, page 7, the propounder of this theory says:

"We have carefully, and, we believe, scientifically, investigated every line of experiment which has professed to show the current which, we believe, is eliminated by contact of metal with tooth-bone. This we have done with the best instruments and apparatus which our country can produce; and we find that such current *has never been shown, much less measured.* Even that curiously ingenious line of experimentation upon this subject, which was presented at the Centennial Meeting of the American Dental Association, and which gave to our profession that scale of relativity known as the 'Harvard Tension Series,' in which gutta-percha was placed at zero and gold at 200, and which gave those who had faith in gold such a 'black eye' (as it was expressed), we pronounce utterly worthless, and without any scientific basis." And again, the same author says: "Now you see, gentlemen, that, notwithstanding the fact that we are unable, as yet, to *demonstrate the existence of a current*, yet, nevertheless, the *reasonableness* and *consistency* of our theory is such, that we may say that gold, being a good conductor, and being itself unattacked, when placed in contact with tooth-bone must, on general principles, cause excessive electro-chemical action, which action must eventuate in the disintegration of tooth-structure—*and therefore* gold is the worst material to use, when a tooth is of such structure and in such condition as that it needs something which will help preserve it."

Here we have it! It is NOT *demonstrated*, but *it is* SUSPECTED! What reasoning is this to present to a body of scientific men who are searching for the truth?

And here I make my eleventh point against the "reasonableness" and "consistency" of this great discovery.

Eleventh.—The propounding of this "New Departure" presupposes a *theory*, which is the curse of study. Any one who is committed to such a thing, is honestly liable to the charge of laboring to establish a foregone conclusion—of working to prop an opinion formulated before all the evidence is in—of pronouncing the shield all one color before looking at both its sides. Study should be to reach truth, not to sustain an expressed opinion. True scientific men, searchers after truth, do not start out with a theory and then endeavor to find seeming facts to substantiate it. They first accumulate their proven points, and from them deduce laws. All the scientific world has learned to shun the man with a theory. It has passed into an axiom to "beware of hypotheses." According to the confession of one of the propounders of this new doctrine, the whole matter rests upon deductions elaborated from an uncertain brain, rather than from an indisputable laboratory, and consequently is, until established by practical tests, unworthy our serious attention.

Heretofore I have been considering, more particularly, Dr. Palmer's electro-chemical theory. I now desire to say a few words concerning plastic fillings. On this point I find this modern "house that Jack built" divided against itself, and all the principles laid down for the guidance of its constructors, deliberately ignored or determinedly contradicted by their authors.

Dr. Palmer says that the multiplication of elements in a compound intensifies electrical conditions, and therein corroborates the voice of science; yet the "New Departure" urges the use of complex compounds in place of simple substances, for the avowed purpose of avoiding that which, in another place, it declares intensifies the disturbed condition. Is this a part of the "consistency" and "reasonableness" of the new theory? All hydro-carbon gums, as gutta-percha, readily undergo the molecular changes which generate electrical conditions. Gutta-percha will slowly disintegrate, even in air. You all know how the surfaces of such fillings decompose and become spongy in some mouths. Theoretically (and the disciples of the "New Departure" cannot object to this manner of viewing the subject), the more simple the substance, the less is it affected by chemical or galvanic influences. The union of gold and tin is much more liable to develop a current than either alone. According to all scientific testimony, compounds are liable to evolve complex electrical currents which simple substances avoid. Of all the metals, gold is the least oxidizable, and the most stable, and hence, from the stand-point of evidence adduced by the "New Departure" itself, it is the very *best* material with which to fill teeth.

On *prima facie* grounds (the favorite method of argument with the students of the "New Departure") compounds are, then, unfit to put in the mouth at all. None such are entirely stable, and the more complex their elements, the greater the probable electrical changes. German silver (nickel and copper) always tastes badly, because in the presence of the fluids of the mouth electrical changes are induced. The molecular changes attending the crystallization of amalgam, especially when accompanied by thermal disturbances, as in the mouth (it is *reasonable* and *consistent* to suppose), *must* develop a galvanic current; and accordingly there is almost universally a bad taste succeeding the introduction of amalgam fillings.

But on this subject I cannot do better than quote Dr. Palmer—he who has furnished, ready-made, the basal theory of the "New Departure" (for the author of the paper read before you a year ago announced himself as simply the mouth-piece of Dr. Palmer). In the paper wherein Dr. Palmer first made known the result of his studies (read before the New York State Dental Society in 1874, and already quoted from), he says (Transactions of the New York State Dental Society for 1874, page 155):

"A porous tooth containing an amalgam plug has in it the elements of a minute, yet intense, battery, capable of decomposing not only the plug, but the tooth around it; this is in accordance with a law of chemical affinity. * * * * Chemical affinity cannot be cheated of its action, and the greater number of elements there are in a battery, the greater number of currents and counter-currents there will be; and galvanic action takes place on all surfaces of the mass, and within as far as moisture extends. We look in vain for amalgam plugs to be bright on the surfaces in contact with dentine. The action is between the compound and the mercury; while, in tin, only the outer surface is acted upon; that is, tin or gold represents one element each; and before any galvanic action can take place between such plugs and dentine into which they are inserted, there must be a space for a fluid to excite action.* With amalgam, the moisture in the tooth-bone is sufficient to communicate the current which exists in the plug to the tooth, and thus enlarge the cavity, or diminish the plug, or both.† * * * * The fact is, the addition of metals to a compound only complicates galvanic action."

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* That is to say, that any gold or tin plug which can excite electrical action prejudicial to a tooth, *must* have been *so badly inserted* as to allow space for penetration of moisture between it and the tooth; and hence, that a gold or tin plug, *properly inserted*, must be the *best* for the tooth, *since no galvanic action can occur between it and the dentine.*—W. C. B.

† Compare this statement with Article IX of the "New Departure", "Amalgam, *per se*, is an excellent filling material."—W. C. B.

Thus, then, we find that the author of the electro-chemical theory can be successfully quoted against himself; and he asserts that amalgam compounds only intensify that electrical condition which, we are told, is the main source of tooth-decay.

And now, in conclusion, I can only say that I have examined this matter as carefully as possible, and without any preconceived theories to establish. I have corresponded much with Dr. Palmer, and have endeavored to arrive at the *truth*. I desire to be courteous to those gentlemen with whom I am compelled to differ; but my courtesy does not go so far as to force me to accept their conclusions without a careful preliminary examination. For the results which they ascribe to galvanism, I am certain we need not go far to discover another cause, one much more in accordance with scientific law, and observed and recorded facts.

The following paper was then read:

THOUGHTS UPON THE ELECTRICAL ASPECTS OF THE "NEW DEPARTURE."

BY JAMES E. DEXTER.

I was lately asked whether there are any good reasons for supposing that electrical action ever exists between the substance of a filled tooth and the filling material it contains. To this I then answered, that it depended upon what the filling material might be. But this answer has since appeared to require some elaboration; hence I amend it as follows:

It is one of the most firmly established laws of electrical science, that chemical action is, always, and under every form of circumstances, accompanied by electrical activity, either static (passive), or dynamic (active). Hence, if chemical action occurs in a tooth, electrical action will also, and simultaneously, occur in that tooth. Now, if the filling material be of a character to be affected, *chemically*, by the agents at work in the tooth-substance, then to the chemical disintegration of the tooth will be joined that of the filling; and, as electrical action was the concomitant of the chemical activity in the tooth-substance, so also will it accompany the chemical action going on in the filling material. So far, these two sets of chemical and electrical activities may, in theory, progress separately and independently. But, if the filling be of such a character that it, or the chemical reactions it occasions, may chemically affect, or be affected by, the tooth-substance or *its* chemical reactions, *then* there will be reciprocal electro-chemical action between the tooth and its filling. Under no other circumstances than these can I see a possibility of electro-chemical (electrolytic) activity between a tooth and its filling, in the mouth.

From this view it would naturally result that a tooth might be chemically disintegrated while its filling remained intact; or, that the filling might waste away while the tooth remained unhurt; and, in fact, such is the case. We constantly see fillings tumbling out of cavities, the walls of which have softened and broken down around them; and, on the other hand, we all know how oxychloride or gutta-percha fillings require renewal, even in positions where they are not subject to physical wear. In the first case, the filling material is unaffected by the chemical forces at work in the tooth-substance, and therefore remains unhurt. In the second case, the filling material happens to be the most open to attack from the same forces (nearly always present in the mouth), and therefore yields before the tooth-substance. In either case, there is electrical action coexistent with the chemical operations; but, if the filling is not chemically affected, there is no electrical action *between it and the tooth;* and, on the other hand, if the tooth is not chemically affected, there is no electrical action *between it and the filling.*

It may be objected to these conclusions, that in an ordinary voltaic combination of zinc and carbon, the carbon element always remains unaffected by the electrolysis, and that such a combination derives its increased electro-motive force from the very fact that one of its elements is not at all affected, chemically, while the other is very easily attacked. And also, my conclusions may, at first sight, appear to be in opposition to the well-known electro-voltaic law, that the greatest electrical activity of a voltaic battery is obtained when one of the elements is not at all attacked by the electrolytic force. But these contradictions are only in seeming; for *a filled tooth has little in common with a voltaic combination, and hence cannot be brought under the laws governing that combination. But such a tooth has everything in common with chemico-physiological operations, and therefore,* I think, *should be viewed solely in its relations to such forces.*

I have lately been reading Dr. Chandler's translation of Dr. Magitot's work on "Dental Caries," and am pleased to find that his theories of the causes and methods of that disease seem to uphold a view in relation to the so-called "failure of fillings" which I have for some time held. My view may be thus stated:

It is not the *fillings* which fail, but the *fillers.* In other words, the disintegration of tooth-substance which so often occurs *after* the tooth has been filled, is simply a *prolongation or renewal of the original attack of caries* to which the tooth had been subjected, and which the *filling operation had failed to cure or prevent.* Hence it appears to me, that to claim that electrical action causes the disintegration of tooth-substance *after* filling, is equivalent to also claiming that it caused such disintegration *before* filling; which is as much as saying, that dental caries and electrolysis are one and the same thing. This I do not think any of us will admit to be true.

If my view of the possibilities of electro-chemical action between the tooth and its filling be correct, it must follow that, except under the conditions stated, electrical action has nothing to do with the breaking down of tooth-substance after filling; and that, even under those conditions, it is present simply as an unavoidable and entirely incidental accompaniment of chemical activity, and performs no act, by itself, toward such breaking down; *for the causes and methods of which we must look to the chemico-physiological problems offered to us by that semi-pathological condition known as dental caries.*

DISCUSSION.

Dr. Allan: The subject of the "New Departure" is one which I had taken up to investigate independently; and I had intended to write a paper as the result, but the papers read seem to settle the question. I had arrived at the same conclusions as these gentlemen have. During my investigations I prepared some questions, which I sent to several of the leading scientists in the country—men who were simply physicists, not dentists or physicians. These questions were carefully framed so as not to suggest any particular bias of thought. The answers to them invariably negatived, and reversed, the propositions stated by Drs. Flagg and Palmer.* They amount to this—as stated by both essayists—that electrical currents in the mouth are simply the resultants of chemical action, and have nothing to do with disintegration of the tooth-substance.

I have taken another method than that of the "new-departurites" to discover the cause of the failure of fillings. That is, to take filled teeth which have decayed around the fillings and have been extracted, to carefully remove these fillings, and then to examine them with a magnifier. For over a year I have pursued this plan, and I have never yet, in such cases, failed to find ample cause in the fillings themselves for the decay around them. On the other hand, where no decay had occurred, the fillings showed, by their perfect construction, just why they had preserved the teeth. I think that if dentists will take up this line of investigation, they will find cause enough to account for the decay of teeth around fillings, without reference to a condition which has nothing to do with that decay. Dr. Barrett's and Mr. Dexter's papers will go far toward disabusing the minds of dentists of the idea that electrolysis is the disintegrating agent in dental decay.

Prof. C. Heitzman (*New York*): As to the causes of dental decay I can speak only histologically, since I am not a dentist; but I can tell what I have seen. Both the essayists speak highly of Magitot's views, at which I am surprised; for I am sure that Magitot is, in his physiology and histology, far behind the times. I do not think American dentists should rely upon foreign works. We should work for ourselves, and not quote that which is afterward proved incorrect. What I have seen, in tooth-specimens prepared by Dr. Abbott, is entirely against the view of Magitot, that the whole process of dental caries is a chemical one, and without the slightest reaction by the tooth-substance. I am convinced from observation, that so long as a tooth is alive it reacts in the most noticeable and remarkable manner against the decomposing forces, evidently chemical in their origin, which have attacked it. Yet Magitot claims that the whole process of dental caries is strictly a chemical one. Another view, stated by some German investigators, is that caries is produced by the growth of low vegetable organisms. These claim that they have seen rows of *leptothrix* in the dentinal tubules, and that these produce decay. The old method of preparing microscopical dental speciments—dry grinding—could never have settled the question of what decay is. It is only the more recent method of treating fresh teeth with chromic acid, which could determine such considerations. Another view of Magitot—that decomposition of the enamel occurs after decalcification has taken place—is wrong, at least, for living teeth. As long as a tooth is alive, there exists a strong reaction against decay on its part; which reaction we may find to be an inflammatory process; I mean, that the three hard tissues of the tooth become reduced to decay after a condition of inflammation. In ordinary osteitis this process takes place. First decalcification, then the reduction to primary elements; but, from the presence of a certain amount of new material, a reactionary new growth takes place, and a large number of inflammatory corpuscles appear. It is certain, that from the moment when the three hard tissues are broken down into their primary elements, these elements become the seat of growth, and the micrococci form the decayed mass. It is strange that the doctrine of the inflammatory reaction against dental caries, promulgated a hundred years ago by John Hunter, should now re-appear and be demonstrated correct. The essayists have spoken of the electrical action of filling materials. I am not enough of a chemist to decide this question; but what I have seen leads me to believe, as it was said, that it is "not the *fillings* which fail, but the *fillers*."

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*See supplement to the Transactions of this meeting, following the Transactions.—Ed.

MR. DEXTER: Should we understand Professor Heitzman, that dental caries is inflammatory in its origin, or that it is caused by external circumstances against which an inflammatory reaction occurs in the tooth?

PROF. HEITZMAN. The latter, sir.

DR. FRANK ABBOTT (*New York*): I have read Magitot quite carefully, and also Rokitansky, Hunter, Fox, Tomes, and many more, upon the same subject. Magitot is the most pronounced of all upon the question of the purely chemical origin of caries. He claims that decay of the teeth is entirely and altogether a chemical process. This he states clearly, in the "summary" at the end of his book. He ignores everything like life in a tooth. He dissolves the tooth as you would a piece of chalk or lime with an acid. On the other hand, the Germans take the position that caries is due to the growth of a vegetable organism. They say this can be found in normal enamel, but are doubtful if it can be found in normal dentine. They think the organisms enter directly into the tubuli and rupture them. Since they say nothing about the lime salts, I suppose they would have it inferred that the organisms push these out of the tooth. At any rate, they must be got rid of in some way. But, in the examinations which I have been making, I have discovered nothing of the kind. In my specimens the leptothrix appears only after the entire disintegration of the structure; then it appears upon the surface. Also, we then see large patches of what have been said to be micrococci; but it is not yet certain that they are so. We have been able to discover that when the enamel has once been affected upon the surface by an acid, there is a reaction which takes place in the enamel itself; and that this reaction in the dentine is very marked. The powers used by Magitot and other foreign observers were too low to distinguish these effects, which are plainly visible under higher powers.

Mr. Dexter: Will Dr. Abbott allow me to offer a slight correction? Magitot certainly has noticed the phenomenon of vital reaction of which the doctor speaks; but he confines it to the dentine. He speaks largely of it, and has illustrated it by several diagrams.

Dr. Abbott: Magitot positively states that no such reaction takes place under any circumstances.* I hope within a year to present my

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*The following extracts from Magitot's work will show that Prof. Heitzman and Dr. Abbott are certainly mistaken in thier statements regarding it.

On page 31, *et seq.*, in his account of the "Anatomic Lesions of Dental Caries," he says: "Beyond the special alterations in the enamel layer, we find, on examining a thin vertical section of the caries of this period, a phenomenon of great importance, of which the ivory is the seat before it has itself yielded to the invasion of the malady. We refer to a white, transparent zone beneath the altered portion of the enamel layer. * * * * This transparent cone, which has already attracted the attention of several observers, Henle, Tomes, etc., * * * * is the index of the organic resistance of the dental organ, the proof of the contest which the pulp maintains against the invasion of the disease. * * * * This reaction of the dental organ, which has no analogue in the enamel, which passively undergoes the alteration, has its origin in the central pulp excessively stimulated by the external irritation across the thickness of the body of ivory, and through the intermediation of the canalicules. This irritation at once gives rise to a functional superactivity of the pulp, and to an excess of production of the materials which it habitually and permanently elaborates. These new elements, which with Tomes and Owen we will designate by the name of *secondary dentine*, penetrate the canalicules, in them deposit molecule by molecule, fill them, and soon transform the ivory into a compact and uniform mass, a phenomenon which slightly reminds one of the mechanism of condensing osteitis in certain affections of the bones." (We here see that Prof. Heitzman, in this discussion, and Dr. Magitot, in his book, make the same use of osteitis as an illustration of this condition.)

And again, in that "summary" of which Dr. Abbott speaks, it is true that the *first* proposition thereof is in these words: "Dental caries is a purely chemical alteration of the enamel and ivory of the teeth." But the *sixth* proposition (on the same page—260) reads as follows: "Lesions of the ivory, consisting likewise in a chemical decomposition of its elements, may sometimes, though rarely, remain passive, *but most frequently they determine in the tissue phenomena of reaction* that manifest them-researches to the profession. I shall do so as soon as they are ready. I would like to say a word in regard to the "New Departure." I do not think that this question really calls for discussion. I cannot see any grounds for the positions taken by its founders. It is only the man who cannot operate with gold who takes up with the plastic materials and calls them the best.

Dr. Atkinson : I could not excuse myself, should I not take this opportunity of expressing my gratitude and joy over a condition of things which I have heretofore deplored. It is, that my professional brethren know so little of the histology of the teeth. Why should I rejoice at this fact ? If you have paid close attention to that which has been spread before us to-night from competent examining authority and ability, you will see that I rejoice because you have so little of false conception to forget. From the days of Owen we have had the representation of the facts, but not before the present have we had them intelligently interpreted. If you will re-read your histologies in the light of the living matter and in the sight of functional activity, you will then be able to comprehend that something akin to the inflammatory process must be concerned in the disintegration of tissue in the living body. Tomes gives us the line of demarcation of what is called consolidation at some distance from the margin of the cavity; but he, with all the rest, used low powers, and could not arrive at the discovery lately given us by Professor Heitzman—namely, the organization of protoplasm; that it is not like water, an indifferent substance throughout its entire mass ; but that it is made up of more or less condensed portions, even in the structure of the *amœba*, that type of all functioning action throughout the animal economy. In other words, if we understand all that occurs in the amœba, then we have the key which unlocks the entire economy of man. The burden of my song is, that we had better let European investigation alone; that we had better burn up the old books and begin anew; so that the illumination of our understanding may be scientific and regular, in place of the fanciful and fitful lights given by Hunter and other foreign observers.

Prof. L. D. Shepard (*Boston*) : I have taken great interest in the subject treated by the essayists of the evening. I have endeavored to regard and investigate it without bias or partisanship, and have not allowed myself to be influenced by the disagreeable manner (to many) in which it was first presented. The chief value of the matter, to me, has arisen from the fact that these doctrines profess to account for a condition

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selves by the appearance of a cone or white zone, formed by a mass of canalicules obliterated in consequence of a formation of secondary dentine." And again, in the *tenth* proposition (page 261): "*The tooth attacked by caries does not remain passive and inert, but may in some measure undertake to resist its action* by the phenomena of *condensing* dentification of the ivory." Or, still further, in the *twentieth* proposition, (page 262), it may be seen that the direction of progression of dental caries "is modified in some circumstances, sometimes by the nature of the altering agent, *sometimes by the acts of resistance of the tooth itself*."—Ed.

of things which is familiar to my experience—that often, in similar positions in the same mouth, one filling material will preserve the tooth, while another will not. As accounting for this, the theory of incompatibility seems very captivating, at first view. Still, it appears that it really does not do so satisfactorily, and its chief value is a negative one—that of drawing particular attention to the fact I have stated, that there is a difference in the relative preservative powers, so to speak, of one or other filling material in the same mouth. The practice has obtained, to some extent, in cases of young and soft teeth, to fill temporarily with gutta-percha or oxychloride; and the explanations have been given therefor, that this treatment hardened the tooth, or that these temporary fillings would be protective for a time long enough to allow nature to add a sufficiency of lime salts to the tooth. But it has been observed, in this practice, that the tooth substance around certain materials has endured longer than that around others; and it seems to me especially important that the reasons for this should be known; since upon them may be founded a systematic and philosophical method of practice, and an elaboration of practical rules sufficiently explicit to be readily understood, so that the practitioner may be guided in his choice of filling materials in each case by established principles, and not be obliged, on every occasion, to depend upon empiricism. A writer in the *Cosmos* for September last, in dealing with this subject, entirely ignored any distinction between the different oral fluids, grouping them all under the head of "saliva." I think the "New Departure" theory, as presented and advocated, has been pretty thoroughly exploded in the minds of all who have investigated it carefully. But that it has done good by calling especial attention to the condition I have named I think is certain; and in that light I now regard it.

DR. SAFFORD G. PERRY (*New York*): If I venture to express an opinion on this subject at all, I can do so only from the operator's stand-point. If fifteen years of active practice have taught me anything, it is that the measure of my success has depended upon the thoroughness of my operations, irrespective of the materials used in filling.

I have learned, however, that something more than thoroughness is required in the preparation and filling of cavities. Judgment must be used in shaping the cavities so that the margins will not be likely to allow a recurrence of decay.

For instance, on buccal surfaces near the gum I would cut the border of the cavity a little under the gum, and finish my filling there with great care. The gum healing kindly over its edge, protects it at that point.

As the opposite border, nearer the grinding surface, from its position, is comparatively safe, there are then left about such a filling but two insecure borders. These are at the sides of the cavity approaching the proximate surfaces. Here nothing will avail but thorough excavation. Instead of stopping when I suppose I have reached sound structure, I sometimes go a little beyond to be doubly sure of having sound borders.

On the proximal surfaces of bicuspids and molars—and to a certain extent of incisors—I am in the habit of preparing my cavities in such a way as to have the borders of my fillings exposed, and self-cleansing on three sides—namely, along the buccal, across the grinding, and on the lingual sides.

Unless in very strong teeth, and a safe mouth, I enlarge even small cavities, so as to bring the borders of the fillings free, except, of course, at the cervical wall. When the work is done thoroughly in this way there remains but one vulnerable point, and that is along the cervical border. In the nature of the case I don't see how we shall ever be able to overcome the danger at this point. We can only lessen it by giving to this border the nicest care. Sometimes two-thirds of the work on a proximal filling should be given to this point.

I know of no way by which these fillings can be made so safe as by following this general plan:

If the teeth are wedged, and small fillings of any material put in, and the teeth allowed to come again in contact, a recurrence of decay may be looked for in a short time, no matter how much care be given to the operation.

The failure is not due to the material used in filling, but to the fact that the conditions which first induced decay have not been changed. This being my belief, I cannot subscribe to the doctrine of the "New Departure." If I have ever been staggered at all, it has been from seeing the good results from even the careless use of gutta-percha. But then I have to remember that it is so plastic that one can easily make a perfect fit; and it is the good fit that saves the tooth. It is this perfect fit which I try to make with gold.

In coming to a conclusion on this subject, I can only say that I have to depend upon my own experience. I had rather trust that, than rely upon the opinions of others, when these opinions are so diverse. And my experience teaches me that gold is the best material for filling teeth, provided it be used as it should be.

Dr. A. H. Brockway (*Brooklyn*): All teeth ?

Dr. Perry: Some teeth are not worth the trouble and care of gold filling.

Dr. Brockway: All teeth worth saving ?

Dr. Perry: In cases of frail teeth, I should expect to save them more certainly with gutta-percha, renewed when it wears, than with gold; because such teeth would not endure the labor necessary to make a perfect fit with gold. If I could make, in all teeth, as perfect a fit with gold, with as little strain on the teeth, as I can with gutta-percha, I should fill all teeth with gold, and thus preserve them even better than with the softer material, because the gold would wear the best.

Dr. Barrett: About a year ago there was read before this Society a paper, in which were strongly advocated certain doctrines entirely subversive of some of the best-established principles of theory and practice. This paper was published in the Society's transactions, and also distributed far and wide through the journals and by means of pamphlets. The members of the Society have not, as yet (so far as I know), expressed any opinion upon this heresy. Very probably they have considered it entirely beneath their serious consideration. But, as it first appeared through this Society—that source from whence we have learned to expect the highest and best of professionalism—very many practitioners, and particularly the younger men, have been led to believe that it contained truth, and was worthy of their attention; and this the more so from your silence upon the subject; for silence, you know, gives assent. I do not say, gentlemen, that you have concurred in these new doctrines; but you must remember that the greater number of your auditors cannot know what the members of the Society think upon any subject unless you give public expression to that thought; and I know it to be a fact that many men have given their attention, and even their acquiescence, to the new creed, simply because it was promulgated in this Society. Of course we know that the Society, as such, is not responsible for what is read or said before it; and that it simply presents all kinds of ideas or theories to the profession, in order that the truth may be eliminated from them. But all men do not stop to consider the question in this way; and the silence of the members has seemed to give color and consistency to the new doctrines. Now, as the poison (for it is a poison) first appeared in the Society transactions, it has seemed to me that the members of the Society would be doing both themselves and the profession a very great good by expressing their ideas in relation to this heresy which has come before us, and thus aiding to check the deluge of bad practice which is already the result of that heresy.

DR. A. L. NORTHROP (*New York*): Does Dr. Barrett refer to Dr. Flagg's paper?

DR. BARRETT: I do, sir.

DR. ABBOTT: That chicken was not hatched here. Dr. Barrett has said that Dr. Flagg was the mouthpiece of Dr. Palmer, and Dr. Palmer's chicken was hatched at Albany.

DR. BARRETT: But he crowed first here.

DR. ATKINSON: The true inwardness of this whole matter was, that it was a cooked-up thing that nothing should be said in discussion of Dr. Flagg's paper; that the time should be so occupied by the speaker as to estop discussion. But the majority of the members felt, as Dr. Barrett expressed it, that the thing was beneath their notice, and hence nothing has been said.

DR. NORTHROP: Dr. Atkinson states that the speaker was allowed the whole time, in order to cut off discussion. To show that this statement is incorrect, I will say—that Dr. Flagg asked of the Executive Committee a certain length of time in which to present his ideas; that such time was given him without any idea of abolishing discussion, and that the whole of the next morning was given up to that discussion. I do not think Dr. Atkinson has any right or cause to bring such a charge against the Society. There was, as far as I know, no endorsement of the paper by any Society member; but it has brought out wide discussion and experiment, and I think has, in this way, done good.

Dr. Perry: I said before that the "New Departure" had not affected my practice. It has. It has made me a better operator. I feel, more than ever, called upon to protest against inferior materials by doing better work. I do not use so much amalgam as I did before.

Dr. Brockway: In reference to the proposition of Dr. Barrett, I do not think it would be proper for the Society to commit itself officially on the matter. We profess to be liberal. Our object is the discovery of truths. The advocates of the "New Departure" have presented their ideas before us, and the opponents of their doctrines have had equal liberty to present theirs.

Dr. Barrett: I hope the gentlemen did not think I suggested such a thing. I asked for the opinions of individual members.

Dr. W. H. Dwinelle (*New York*): I took an active part in the morning's discussion of that offensive paper. I think I speak the sentiment of the best members of the profession, and of the Odontological Society, when I call it an offensive paper. I myself entered a protest against it at the time. I think that the paper, nevertheless, has done good, by arousing that spirit of antagonism to falsehood which is ever present, though dormant, in the true professional mind. When an operator like Dr. Perry resolves to do better than he has done, in opposition to that paper, it has done a good it never intended. The new system was born of narrowness and incompetency, and there is no good in it, except what appears in antagonism to it. I do not say that the materials advocated by the "New Departure" are bad in themselves. Like everything else, they are good in their place. But to attempt to restrict us to their use alone is monstrous. Still, good comes out of it, in the sense that good comes out of all evil. It seems true that the influence has been, in some degree, bad upon the profession; but I think that the almost universal protest of silence has been, and is, sufficient. This Society has been subjected to a vast deal of abuse during its long life; but it has survived it all, and is stronger than ever.

Prof. Geo. T. Moffatt (*Boston*): When Dr. Perry was speaking, I was inwardly applauding his conclusions. I believe in good, thorough operations with gold. With such fillings, and by good operators, teeth can be saved. Such practice has endured the test of many long years, and, I believe, will continue to endure it successfully. I have not attempted to investigate the electro-chemical theory, for my time has been fully occupied in saving, to the best of my ability, the teeth of my patients.

PROF. SHEPARD: I do not think that the gentlemen living in cities have any correct idea of the extent to which this new theory has permeated the country. There are two country societies near my locality which I have long attended. To these come practitioners from all the villages and smaller towns around. Last spring this question was the great subject of discussion in these societies; and, as a result, the suburban practitioners became deeply interested in it. As they interpret the theory, it is simply a question of "amalgam." The doctrine was widely spread by the *Cosmos*, and through distribution of printed slips, which were scattered everywhere. For a time it certainly did a great amount of harm, in increasing the number of amalgam operations. But such discussions as these will give a healthy reaction. In attending the meetings of these societies, I felt it incumbent upon me to caution my friends against the hasty adoption of any new theories, and explained as well as I was able the directions and conclusions of the theory. But it has certainly caused a strong tide of harm. At least, that is the case in New England, and from what Dr. Barrett has said, I suppose it is the case elsewhere. The doctrine, by being presented before this Society, received some apparent endorsement of respectability; although, of course, the Society is not responsible for that fact. But you know the adage, "People are known by the company they keep." Perhaps there has not been enough discussion of the question by the opposition. But I think that now the extent of the injury is becoming known, that fault will be remedied. I shall meet the societies of which I spoke during the coming month, and shall have gathered, during this summer and at this meeting, a strong array of testimonials on the subject.

DR. O. E. HILL (*Brooklyn*): I think there is much justice in what Dr. Barrett has said. I thought, at the time, that the Society made a mistake in giving the right to occupy the whole evening. Never, in all my experience of dental societies, have I seen so much excitement in a dental meeting as in that one. I very much regret that we did not take time that evening for the discussion, while the excitement was at its height. Still, there is another view to take of the subject. I think it showed wisdom in the Society to wait until something was known in relation to the doctrines advanced. It has taken Dr. Barrett a little time to reply to Dr. Flagg's paper, and I do not think he can ask us to do much more than he has done himself; and the case is the same with many others. While traveling in the country I have seen the same harm from the "New Departure" that the gentlemen have mentioned; and I am glad Dr. Barrett has set the ball rolling in the opposite direction. We all know the purpose of the Odontological Society is to get ideas on every subject and from every quarter, and present them to the general profession for its verdict. But to sift any matter of importance takes time. I am sure the "New Departure" doctrine, though bad enough in itself, will eventually do us good, instead of harm, by showing us what to avoid, as well as what to commend.

Dr. W. A. Bronson (*New York*): As Chairman of the Executive Committee, perhaps I may be indulged in a matter of history. Some time during last autumn we received an intimation from Dr. Flagg to the effect that he had a paper which he desired to read before the Society, and that he wished to have a special meeting called for its consideration, of which he would occupy the whole time. As the Annual Meeting was near at hand, we requested Dr. Flagg to wait until that occasion, to which, after some correspondence, he consented. The evening session of the Annual Meeting appeared to afford the best opportunity for the presentation of Dr. Flagg's ideas, and was accordingly selected for that sole reason. There was no thought of cutting off discussion. On the contrary, a paper by Dr. Chase, on the same general subject, was placed first upon the programme for the next morning, with the idea of including both the papers in one discussion, and thus saving time. As to the character of Dr. Flagg's essay, the committee knew nothing of it until it was delivered. He was well and widely known in the profession, and the Society was glad to have him come before it. I cannot agree with Dr. Hill when he says the Society made a mistake. The "New Departure" has developed more experimental and general investigation than almost any other question presented to the profession in a long time. It has been the live question of the year. While I, in common with most of the profession, repudiate its doctrines, yet I feel that the Society will always be glad to become the medium of presentation of any ideas or propositions which will develop an equal amount of professional research and discussion.

Adjourned.

SUPPLEMENT.

Questions Propounded by Dr. George Allan to a Scientist, with their Answers.

Question 1: If two metals are near each other in the same tooth, or in adjoining teeth, by which metal (in the case of gold and tin) would the tooth suffer most injury?

Answer: The tooth would be most apt to suffer injury from the most easily oxidized metal; in the case of gold and tin, from the tin.

Question 2: Can the pure gold placed in a cavity in a tooth as a protection against decay (caries, so called), induce electrical currents, in the absence of another metal or metals near by?

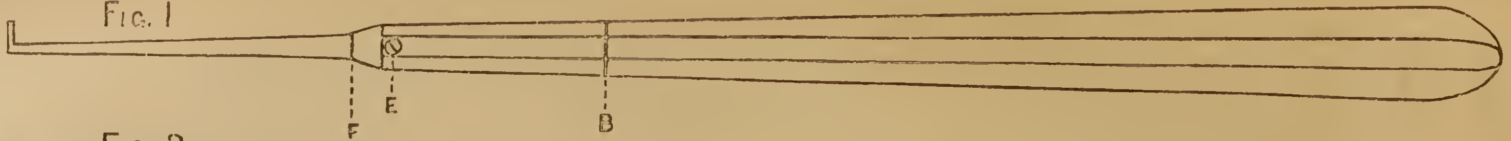
Fig. 1

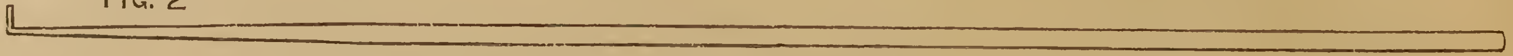
Fig. 2

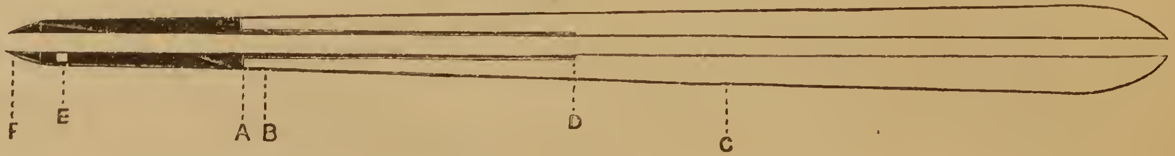
Fig. 3

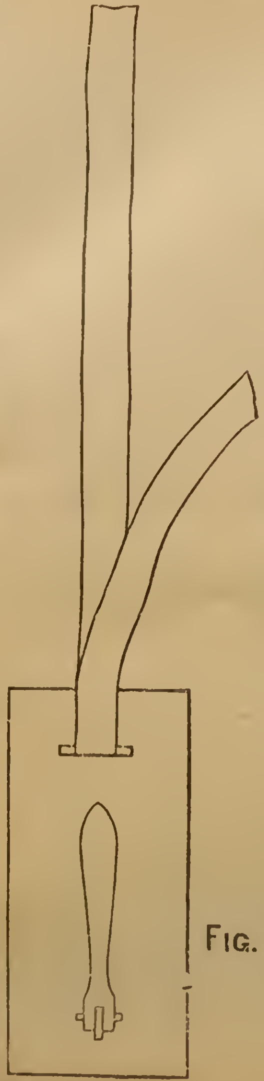
Fig. 7

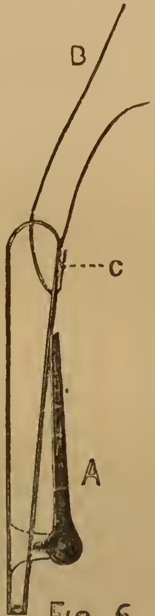
Fig. 6

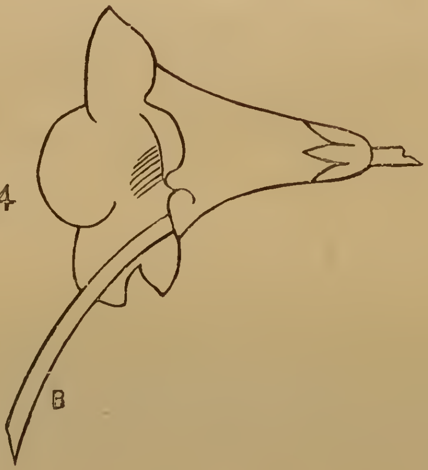
Fig. 4

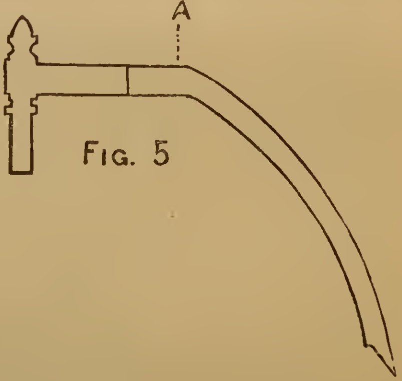
Fig. 5

M.W. Phillips — William Herbert Rollins

Answer: Gold would not produce an electrical current in the case stated, since it would not be acted upon in any way by the saliva.

Question 3: If such currents are produced, what effect, direct or indirect, can they have on the substance of the tooth?

Answer: I am unable to say. They might cause decay: they might, on the contrary, preserve the tooth. There are no facts bearing on this point, so far as I am aware.

Question 4: Would gold be more apt to produce such electrical currents than tin, or a compound composed of tin 40 parts, silver 10 parts, mercury 50 parts?

Answer: Gold would be far less apt to produce such currents than tin, as being oxidized with difficulty, while tin oxidizes readily. The compound would probably cause the tin to oxidize more rapidly than if the tin were there alone.

Society Communications.

THREE PRACTICAL SUGGESTIONS.

BY WILLIAM HERBERT ROLLINS.

Perhaps the following modifications of existing instruments may be of value to some members of the Odontological Society.

It is with this idea that they are presented to the Society.

Figures 1, 2, 3, show a simple form of excavator. It seems to have the following advantages:

Without increase of weight the handle is larger, giving a firmer hold. Being mainly of wood, one appears to feel more distinctly the position of the point, as shown by the vibrations sent to the fingers. After the first cost the excavator is economical, because the steel rod can be used until three inches long. No forging is required in repairing. The wire is small enough to grind to shape on an emery wheel. In the ordinary excavator, from repeated heating in forging, when repairing, the steel becomes too brittle for service. In this instrument only the extremity needs heating, and that simply to bend into shape and to temper. This heated portion can be cut off when the instrument breaks, leaving fresh, unworked, unheated steel for the new point.

Fig. 1. From A to B extends the steel ferrule. E shows a screw which prevents the wire from turning. The wire is ground slightly flat on one side. This screw is not necessary, as a little shellac is efficient. Fig. 2 shows the round steel rod, number 42, Stub's gauge; Fig. 3 a section of the handle shown in Fig. 1. The steel ferrule, A B, Fig. 1, extends inside the wood to D, Fig. 3, to make the handle strong.

From the figure it is evident that the handle is hollow. This hollow is filled by the steel rod, Fig. 2, extending the whole length of the handle when the instrument is new.

Fig. 5 shows a defect in the White engine. The cable sheath breaks at A. Fig. 4 represents a metal flower, from which projects the cable sheath, B. As the latter lies on a curve there is no danger of its breaking.

Figures 6 and 7. A simple form of coffer dam holder. It is made of steel. Fig. 6. A side view. The lever, A, when raised, allows the jaws to spring open; then the rubber can be inserted and the lever depressed. B represents the band going around the patient's head. Elastic braid is not permanent. It is not necessary; the rubber furnishes the elasticity. Its place is supplied by brown worsted braid, which is fastened at any given point by the recurved hook, C, in Fig. 6. Each clamp being provided with one of these hooks, the excess of braid can be diminished from either side without the patient moving her head. This instrument has been used four years. It is efficient.

Society Notices.

CHANGE OF PUBLICATION.

After this date the proceedings of the New York Odontological Society will cease to appear in this journal. Their publication, however, will be continued through some medium not yet decided upon, and of which the members will receive due notice.

The Secretary takes this opportunity to request those who desire to present papers before the Society during the coming year, to signify such intention to him, giving the subjects of which they will treat, at as early a date as possible, so that each paper may be assigned its proper place in the meetings of the year.

A. H. Brockway, *Cor. Sec.*,
No. 13 *Greene Ave., Brooklyn, N. Y.*
Nov. 1*st*, 1878.

Editorial.

Treatise on Dental Caries. *Experimental and Therapeutic Investigations by* Dr. E. Magitot, *Laureate of the Institute of France, etc., etc. Crowned by the Academy of Medicine. Translated by* Thomas H. Chandler, *D.M.D., Professor of Mechanical Dentistry and Dean of the Dental School of Harvard University.* Boston, Houghton, Osgood & Co., 8vo, cloth, pp. 275, price, $2.50.

Whatever may be thought of the theories of dental caries and its treatment as advanced by this author, it is certain that the work is most admira blysystematized and arranged for purposes of study and reference.

This systematization is, at the first glance over the book, the feature which first strikes the reader, and induces a desire for further examination. We have seldom seen a work of this character so excellent in this respect.

As to the theories of dental caries held by the author, they seem to consist, mainly, in three points, which may be summed up as follows: Dental caries is a purely chemical alteration of tooth-substance, always external in origin and inward in progression, disparate, exciting phenomena of reparative reaction in the tooth-pulp through *condensing dentification* of the ivory. Its agent or cause is the saliva, become the medium of acid fermentations or the vehicle of foreign substances susceptible ot altering the tooth-tissues. Most frequently the fermentescible aptitudes of the mouth depend upon local or general morbid exciting causes, though they may occur during perfect general health, and are even transmitted by heredity.

The symptoms are divided into three successive periods; the first, confined to the enamel; the second, to the dentine, without penetration to the pulp-cavity; and the third, to the dentine, including penetration to that place. Caries is susceptible of "spontaneous cure," and is radically curable in the immense majority of cases. The prophylaxis "should have for its aim the suppression of contact with the agents of alteration or the neutralization of their effects," and the general curative treatment is *isolation.* In the first period all therapeutic treatment is useless, and obturation or resection should be at once practiced; in the second, "astringents and superficial caustics" are employed; while the third indicates "profound caustics and destruction of the pulp." The term of possibility of cure of this lesion "is marked by the development of grave lesions of the alveolo-dental periosteum, occasioning local disorders or general disturbances necessitating the extraction of the tooth."

Such, condensed, is the author's summary of what certainly, at least in form and arrangement, is an admirable work. Still, while one is struck with the apparent coherence and *oneness* (so to speak) of the theory and the experimentation with many facts long established in relation to this leison, one hesitates to accept, upon the researches of a single observer, the theory that dental caries is not a pathologic condition, but dependent upon purely external and adventitious circumstances.

The book has been excellently translated by Professor Chandler. It is well printed, on clear paper and in good type, the illustrations and plates are valuable, and it upholds in every respect the long-established reputation of its publishers.

Dental Selections.

THE MECHANICAL GENESIS OF TOOTH-FORMS.

BY C. N. PEIRCE, D.D.S., PROFESSOR OF DENTAL PHYSIOLOGY, DENTAL PATHOLOGY AND OPERATIVE DENTISTRY IN THE PENNSYLVANIA COLLEGE OF DENTAL SURGERY.

(*Read before the American Dental Association, Niagara Falls, August,* 1878.)

We have received from Mr. John A. Ryder his paper upon the above subject, just published in the *Proceedings of the Academy of Natural Sciences of Philadelphia.* There is so much in it of interest that is pertinent to the subject of dental histology, that we trust a *résumé* of the paper will prove acceptable to the Association as a part of the report upon Histology.

Some of the conclusions Mr. Ryder arrives at from his study of the osteology of the Mammalia are as follows :

1st. That in *Carnivora* and *Omnivora* the jaws were simply opened and closed during mastication, without lateral movement of the mandible or lower jaw, and that the earliest and most constant type of tooth accompanied this movement—that is, that the tubercles or cusps composing the teeth do not to any extent depart from the short-rooted type with conical tubercles, styled by odontologists bunodont. That the distance apart of the series of molars of opposite sides, of both upper and lower series, was approximately alike—that is, that in closing the jaws the external or buccal cusps of the upper series were brought exactly upon a line with those of the lower, not over them, as is the case in all *Herbivora*, and to some extent in man. This condition he has styled isognathism.

2d. That in the *Herbivora* the jaws were opened and closed in mastication with extensive lateral movement of the mandible; and that the teeth were by this greatly modified in respect of their tubercular constitution, the tubercles being of the type known as crescentic, giving us the long-rooted selenodont type of tooth. That in these the width of the jaw, or the distance apart of the upper series of molars of opposite sides of the head, greatly exceeds the same measurement in the mandible, which results in the external or buccal cusps of the upper series closing over and external to the buccal cusps of the lower series. This condition he has styled anisognathism.

3d. That in some *Rodentia* and *Proboscidea*, the mandibles were moved in a backward and forward, or antero-posterior direction, which he has termed the reciprocating movement, with which there was also a corresponding tubercular modification, which he calls trichecodont—three tubercles forming transverse ridges, frequently obsolete, or greatly flattened transverse lamellæ, composed of elongated and united tubercles soldered together by a thick cementum layer (*Elephas*). Isognathism is usually a characteristic of this subdivision.

4th. That in a subdivision including a part of *Rodentia* and *Proboscidea* (mastodons), the movement of the mandible was both reciprocating and lateral, with a still more complex type of dentition as a result, which he has styled ptychodont—enamel folded and fluted upon itself longitudinally and transversely. These jaws are usually anisognathous.

The foregoing groups Mr. Ryder has tabulated in the following manner :

1. No lateral movement	(Omnivora)	Isognathous.
2. Lateral movement	(Herbivora)	Anisognathous.
3. Reciprocating movement	Some Rodentia Some Proboscidea	Isognathous.
4. Lateral and Reciprocating movement	Some Rodentia Some Proboscidea	Anisognathous.

These observations, based upon investigations made not only upon the skulls, but also upon the living animals, afford, he thinks, the key whereby to correctly interpret the morphological history of the teeth of the higher groups, especially when brought to bear on the interpretation of the teeth of the great number of herbivorous remains which the rocks have yielded in recent times, as intermediate or antecedent forms.

The number of kinds of excursions made by the mandibular rami is limited by structural impediments, since a bar fixed at one end and free at the other, to which the mandible may be compared, is capable of but a few distinct movements. We find these to be essentially those mentioned in the definition of the four groups ; few others are possible or conceivable. The first movement is the vibratory one in a vertical plane; the second is the vibratory movement in both the horizontal and vertical planes ; the third is the vibration of the rami in an approximately horizontal plane, neither lateral nor vertical, but an antero-posterior or reciprocating movement, paralled to the median axis or line ; the fourth is that which combines to a great extent the second and third. It is also to be observed that the lines described in most cases are not straight, but only approximately so, they being more or less curvilinear. With these four distinct types of mandibular movement there are as many distinct types of tooth-modification, to which almost all the forms of teeth of Mammalia yet known may be referred. The bunodont type is that characteristic of Group 1, and in which the tubercles have not been modified, because there have been no movements of a proper kind to produce the modifications in the enamel foldings, as observed in the longitudinally or the transversely-folded enamel crowns of the lophodonts (ridge or hill tooth). To this foregoing Group 1 belong also all the haplodont types (simplest forms), as observed in the toothed whales.

According to the doctrine of mechanical dental differentiation, the foldings of the enamel in the teeth of Groups 2, 3 and 4, whether they be longitudinal or transverse, are due either to the lateral or reciprocating movement of the jaws. The sub-group—selenodonts—so called in consequence of the crescent-shaped foldings of the enamel, of which the deer is a familiar example, is perhaps the most striking illustration of all. The characteristic crescent-shaped tubercles, the author thinks, have probably been evolved by a very slow process of flattening and bending outwards or inwards of the cornu of the tubercles, due to the strains exerted in masticating the tough woody food. The movement in this case, being constantly in one direction, makes it still more probable that such has been the history of the process.

In a subsequent communication from the author, he says: "I have never yet been able to satisfy myself in regard to the direction of the motion of the ramus when the jaws are in contact, though it has occurred to me that it would make but little difference, since the obliquity of the crowns of both the upper and lower series in opposite directions would render it a matter of little consequence whether the movement were from within outwards or from without inwards, because in both cases the mechanical conditions necessary to effect the requisite differentiation would exist."

He says further, "It is, moreover, noteworthy that in no instance have I been able to discover that the plan of the enamel foldings of the teeth in any lophodont was such as not to agree with the direction and kind of mandibular movement."

From the views advanced and the illustrations confirming them, which we have extracted from the paper in question, as well as some few which we shall yet present, the author feels that he has good and valid reasons for regarding "the condylar articulation of the mandible as the odontomorphic or tooth-shaping centre—that is, that they, the condyles, are the fulcra from whence all the dental impacts incident to mastication are controlled, giving us certain specific kinds of persistent movements which could effect modifications. The persistence of the type of movement renders its effect cumulative, whilst the addition of the factor of heredity renders it permanent."

In speaking of odontomorphic centres, the author says: "While making measurements of the skulls in the collection of the Academy, some curious facts were elicited. It was observed, that if a pair of dividers were taken, placing one point on the glenoid cavity of the skull or condyle of the mandible, the curvature of the cross-crests and intervening valleys of the molars of the same side would exactly coincide with that produced by a sweep of the free point of the dividers across them. The same rule was found to hold good in regard to the other side of the skull. We were not long, however, in finding that this rule was not universal among selenodonts ; that there were some in which such a coincidence could not be obtained by the method described. It was then observed in these other cases that, if one leg of the dividers was placed on the posterior end of the basi-sphenoid bone, opposite to and midway between the glenoid cavities for the superior molar series, and midway between the condyles for the mandibular molars, the arc described by the point of the free leg would now coincide in the curvature with the cross-crests and bottoms of the valleys of the molars of both sides when extended across their crowns."

For convenience, he designates the teeth the cross-crests of which coincide in curvature with arcs described respectively from the right and left glenoid cavities as centres for the molars of these sides respectively, as *biaxial;* and those where the centre of this coincident arc is medial on the basi-sphenoid bone, or midway betwixt the condyles, as *uniaxial.* These centres may be named odontomorphic or tooth-shaping, since they are the fulcra which control the forces which slowly modify the shapes of the teeth and their component tubercles. The biaxial molar is by far the most numerous, he having observed it in the following orders : *Edentata*, proboscideans, most rodents, perissodactyles, marsupials, and, indeed, most of the *herbivora*, while the uniaxial was confined to the *tragulidæ*, a species of deer, and a few rodents.

The author says : "There seems to have been a metamorphosis of molars and premolars, which proceeded with greatest rapidity nearest the mandibular articulation, where the modifying forces were also applied with the greatest mechanical effect. The mandibular masticatory apparatus of mammals may be regarded as levers, in which the glenoid cavity is the fulcrum, the muscular force exerted by the masticatory muscles the power, and the resistance of the food to the teeth in crushing it the weight. Since the co-efficient of muscular force is one hundred and four pounds per square inch of transverse section, it is easy to surmise what would be the tendency of the exertion of the force of many square inches in section of masticatory muscle upon the jaws and teeth in mastication. It would manifestly not be consumed in the mere comminution of the food, but it must also react upon the structures which were directly subjected to the resulting strains, viz., the teeth. In a mammal as large as the rhinoceros, the area occupied by the mandibular teeth is about five square inches, while the maxillary teeth occupy about ten square inches, as I have roughly estimated from a skull nearly adult; the ratio, then, of the triturating surfaces of the upper and lower series is about as one is to two. These ratios increase apparently as anisognathism increases, and conversely become equal as isognathism prevails—that is, we may select a perissodactyl, such as the rhinoceros, or an artiodactyl, such as the domestic ox, to represent one extreme, and the universal pig as the other."

The articulation of the mandible with the skull presents three well-marked types—viz., that observed in bunodont, with a more or less distinctly cylindroidal mandibular condyle ; the selenodont, with transversely-expanded and superiorly plane condyle, and the lophodonts, with a more or less nearly globular condyle, which in forms with much reciprocating movement becomes elongated antero-posteriorly, narrowed transversely, and fits, in some instances, into a well-marked, longitudinally-disposed glenoid cavity. In those forms in which there is much lateral motion the rami of the mandible are also much more closely approximated than the molar series of opposite sides above; while in those forms without the excursive lateral movement there is little or no such difference in the interval between the molars of the upper and lower series respectively.

It is therefore apparent that the relations supposed to exist between mandibular movement and tooth-forms must be extended so as to embrace not only changes in the form of the teeth, but also changes in the relations of the mandible and the form of their condyles and the glenoid cavities. The whole of these changes have been apparently dependent upon the mode of use of the parts and the force exerted.

It is further to be observed that those animals which have the most powerful masticating apparatus invariably have the most deeply-implanted teeth and the most effective arrangement for the replacement of tooth-structure when lost by wear.

The incisors of many animals having been lost or hypertrophied, either from the assumption of their functions by other parts, as the lips, tongue or trunk, or by substitutions of another function, as in the case of the tusks of the proboscideans, it would seem that mechanical resistance has much to do with their special development, as also seen in rodents.

A summary of the foregoing views the author has stated as follows:

"1. That the earliest and simplest type of mammalian jaw-movement was that in which the mouth was simply opened and closed, without mandibular excursion, and co-existent with the simple haplodont or bunodont molar.

"2. That the development of the various kinds of excursive mandibular movement has apparently been progressive.

"3. That as the excursive movements have increased in complexity there has been an apparent increase in the complexity of the enamel foldings, ridges and crests.

"4. From the fact that the foldings, etc., have apparently been modified in conformity to the ways in which the force used in mastication was exerted, it is concluded that the various modes of crest and tubercular modification are related as effects to the diverse modes of mandibular movement.

"5. It is apparent from the facts presented throughout the context that the mandibular articulations, and correlatively the whole skull, have probably been modified in shape by the movements made by the jaws and the forces exerted in executing them.

"6. From the fact that incisor teeth are partially or entirely absent or relegated to another function in forms which have long prehensile tongues, mobile, prehensile lips or proboscides, it is held to be probable that such disappearance of the incisive dental elements is due to the assumption of their function by the prehensile organs indicated."

These views may also have some practical bearing upon dental science, and show that the edentulous theory advanced by our friend Dr. Thompson, based upon the degeneration of the human teeth, may have some foundation in science. The almost universal prevalence of dental caries and other dental deformities is doubtless in a large measure due to a want of proper use of the teeth in comminuting harder food, which would be a constantly active stimulant, tending to produce a healthier and stronger development.

The long-established and increasing use of soft foods, in the light of the foregoing facts, has an unmistakable tendency to cause the teeth to become diseased, and, if there be truth in the doctrine of hereditary transmission, will in time render the human family more or less edentulous.—*Cosmos.*

Surgical and Medical Selections.

THE DIRECT METHOD OF ARTIFICIAL RESPIRATION FOR THE TREATMENT OF APNŒA FROM DROWNING, ANÆSTHETICS, STILL-BIRTH, ETC.;

WITH A TYPICAL CASE OF EACH, TREATED BY THE AUTHOR, IN WHICH OTHER METHODS WERE NOT IMMEDIATELY PRACTICABLE.

BY BENJ. HOWARD, A.M., M.D., M.R.C.S., ENG.,

Formerly Lecturer on Operative Surgery in the Med. Dept., University of New York : Late Professor of Surgery and Surgeon, Long Island College Hospital, New York State, etc.

As a supplement to a lecture delivered at King's College Hospital, 1877, it has been thought expedient, in compliance with many requests, to publish the Direct Method in the form of rules with illustrations. Acting on this suggestion, I now submit, in the following order—

1st. *Rules for the Direct Method of Artificial Respiration.*

2d. *Some reasons for these rules.*

3d. *Cases which suggested the idea of this method, other methods being impracticable.*

4th. *Cases illustrating the application of the rules of this method.*

5th. *Show the peculiar applicability of this method to cases of still-birth, citing first cases in which other methods were impracticable.*

6th. *Give an account of the origin of the formula of the Direct Method in the difficulty of making the principle and formulæ of other methods understood by laymen.*

7th. *Submit some observations upon the Directions for the Treatment of the Drowned, published by the Royal Humane Society and the National Life-boat Institution.*

8th. *State some of the advantages of this method over other methods in the above directions for public use.*

As in asphyxia from drowning there are conditions *plus* those in apnœa from other causes, I will, for comprehensiveness, submit the method in question in the form of

RULES FOR ARTIFICIAL RESPIRATION IN THE TREATMENT OF THE DROWNED.

RULE I.—*For Ejection and Drainage of Fluids, etc., from the Stomach and Lungs. Position of Patient.*—Face downwards; a hard roll of clothing beneath the epigastrium, making that the highest point, the mouth the lowest. Forehead resting upon forearm or wrist, keeping mouth from the ground.

Position and action of Operator.—Place the left hand well spread upon base of thorax to left of spine, the right hand upon spine a little below the left, and over lower part of stomach. Throw upon them with a forward motion all the weight and force the age and sex of patient will justify, ending this pressure of two or three seconds with a sharp push, which helps to jerk you back to the upright position. Repeat this two or three times, according to period of submersion and other indications.

RULE II.—*To perform Artificial Respiration. Position of Patient.*—Face upwards; the hard roll of clothing beneath thorax, with shoulders slightly declining over it. Head and neck bent back to the utmost. Hands on top of head. (One twist of handkerchief around the crossed wrists will keep them there.) Rip or strip clothing from waist and neck.

Position of Operator.—Kneel astride patient's hips; place your hands upon his chest, so that the ball of each thumb and little finger rests upon the inner margin of the free border of the costal cartilages, the tip of each thumb near or upon the xiphoid cartilage, the fingers fitting into the corresponding intercostal spaces. Fix your elbows firmly, making them one with your sides and hips: then—

Action of Operator.—Pressing upwards and inwards towards the diaphragm, use your knees as a pivot, and throw your weight slowly forwards two or three seconds until your face almost touches that of the patient, ending with a sharp push which helps to jerk you back to your erect kneeling position. Rest three seconds; then repeat this bellows-blowing movement as before, continuing it at the rate of seven to ten times a minute; taking the utmost care, on the occurrence of a natural gasp, gently to aid and deepen it into a longer breath, until respiration becomes natural. When practicable, have the tongue held firmly out of one corner of the mouth with thumb and finger armed with dry cotton rag.

[*Note.*—Avoid impatient vertical pushes; the force must be upward and inward, increased gradually from zero to the maximum the age, sex, etc., may indicate. Abandon no case as hopeless within an hour's useless effort.]

For the Public.—In answer to requests from several medical gentlemen, I transcribe, with slight alteration, the following rules of the Life-Saving Society of New York:—

RULE I.—*To drain and force water from the Lungs and Stomach.*—INSTANTLY place patient face downwards, a hard roll of clothing being placed beneath pit of stomach to raise it as much as possible above the level of the mouth. Put one wrist of patient under his forehead to raise mouth off the ground. With hands well spread upon patient's back, above the roll of clothing, throw upon it your whole weight with a forward motion, and keep up the pressure about three seconds, so as to force all water from stomach and lungs out of the mouth, ending the pressure with a push which will help to jerk you back to your upright position. Repeat this once or twice, and then QUICKLY proceed with

RULE II.—*To make the patient breathe.*—Turn the patient face upwards, the same hard roll of clothing being now beneath his back, the shoulders slightly drooping over it. Bend head backward and downward, putting throat on the stretch to the utmost. Place hands of patient on top of head (one twist of handkerchief or string around the crossed wrists will keep them there). Rip or strip all clothing from waist and neck.

Now kneel astride patient's hips. Grasp front part of chest on both sides pit of stomach; your thumbs pointing to patient's chin, your fingers fitting into the grooves between the short ribs.

Fix your elbows firmly, making them one with your sides and hips; and then, firmly pressing the sides of the patient together and using your knees as a pivot, throw yourself slowly forward for two or three seconds until your face almost touches the face of the patient, and your whole weight presses upon his chest. End this pressure with a short push which *suddenly* jerks you back again to the upright kneeling position.

Rest three seconds while the ribs spring back; then repeat this bellows-blowing movement as before, gradually increasing the rate from seven to ten times a minute; but take the utmost care, on occurrence of a natural gasp, not to interrupt it; but, as the ribs fall, gently press them and deepen the gasp into a longer breath. Continue this until the natural breathing which you are imitating needs no further assistance. If all fails, keep on; because any moment within an hour's effort, you may unexpectedly be rewarded with success.

[*Note.*—If a second person be present and can do it, the tongue should be held out of one corner of the mouth by the thumb and finger armed with a piece of dry cotton or linen rag. Of course, it is understood the force employed will be moderated in both rules according to the age and sex of the patient.]

SOME REASONS FOR THESE RULES.

Some Reasons for Rule I.—The principal intention of this rule is to accomplish without an assistant the removal of obstructing fluids, etc., from the lungs and stomach, alternate inspirations intervening between each effort.

A hard roll of clothing is specified for the elevation of epigastrium as directed, partly because the material for it is sure to be at hand, partly because the clothing of the drowned man being wet is the better adapted for the purpose. The compression thus made by Rule I. is applied just where the obstructions exist, and it can be regulated as may be deemed expedient. The forward motion accompanying the pressure promotes propulsion. The line of descent from the stomach to the mouth causes ejection to be followed up by rapid and complete drainage. The slight elevation of the forehead and extension of the head promote gravitation of the tongue and freedom of exit from pharynx, mouth and nares.

Slight prolongation of the pressure upon the back has been directed in order that ejected material may, before the removal of the pressure, get clear beyond the reach of the inspiratory suction accompanying the rebound consequent thereupon. It is hardly necessary to remark that in view of the unavoidable inspiration following each effort for injection, even though no fluids be found to have accumulated, no time has been wasted. Not unfrequently the fundamental and predominant condition in the asphyxia of people rescued from drowning is one of profound syncope, from the fright attending recent immersion; and for this condition the position directed in Rule I. is indisputably the supreme remedy also.

Some Reasons for Rule II.—By this rule it is intended—

1st. Without an assistant, to obviate anatomical causes of respiratory obstruction.

2d. To obtain the greatest possible thoracic expansion.

3d. To produce the greatest practicable alternate thoracic compression, and thus exchange of air, and this with regularity and rhythm, and with least possible fatigue to the operator.

The anatomical causes of respiratory obstruction in the ordinary supine position in asphyxia, beginning from below upwards, are: 1st, flexion of the thorax upon the abdomen; 2d, gravitation of the epiglottis; 3d, gravitation of the tongue; 4th, gravitation of the velum palati; 5th, flexion of the head. The nature of these obstructions and an explanation of the anatomical remedy against them have been fully set forth by me in a paper, an abstract of which was read before the Royal Medical and Chirurgical Society on the 14th inst.,* and can here be but barely adverted to. For the flexion of the thorax upon the abdomen, the consequent pressure from above downwards, and from below upwards, with the embarrassment of the diaphragm between, is substituted extension, and all the opposite conditions incident to the change.

The utmost extension backwards of the head and neck, as directed in Rule II., provided the mouth be not too much open, produces simultaneously—

1st. Elevation of the epiglottis, vertical or otherwise, at will.

2d. Prevents the tongue falling against the back of the pharynx by the same law which, in the ordinary position, compelled it to fall there.

3d. Interposes a tense velum palati between the tongue and the pharynx, establishing a post-oral air-way from the glottis to the nares secure against all intrusion, with such other advantages from extension of the head as naturally antagonize the obstructions arising from flexion.* Whatever danger there may be in the alleged cerebral anæmia which has been assumed to exist in chloroform-poisoning, so much insisted upon by Nélaton and Sims, this head-down position also long ago anticipated this, and antagonizes it.

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*Proceedings Med. Chirurg. Soc., May 14th, 1878.

The thoracic expansion sought by Rule II. is obtained—

1st. By straightening the dorsal curvature of the spinal column. The weight of the trunk resting at this point with its greatest thoracic curvature upon the hard roll of clothing, the curve is diminished, the spinal column is proportionately straightened and lengthened, many of the ribs are moved upward, the interspace between them is increased, the sternum is carried forward, and the general thoracic circumference is thus enlarged.

2d. By extension of the head and neck. This brings into play the scaleni, sterno-cleido-mastoidei, and all the muscles from the head and neck attached to the upper part of the thorax.

3d. By extension of the arms. This being directly upwards and backwards, instead of upward and forward, as in Silvester's position, not only are the same muscles his position uses made more tense, but other muscles, the latissimus dorsi, are also brought into play, and thus the superior costæ, the inferior costæ, and as nearly as possible all the parts of the entire thorax, are submitted to the traction of the muscles presiding respectively over the expansion of those parts.

The force employed for thoracic compression is elastic, well distributed, well directed, and can be easily regulated, from the weight of the hand to the maximum weight and strength of the operator. In both the other methods, the hips and raised shoulders are piers upon which the arched trunk rests; the highest point of the arch is the most elastic part of the chest, and beneath the point of pressure is a hollow space; thus there is pressure without resistance, and this yields not the *com*pression sought. In Silvester's the part where the pressure is to be made is the farthest reachable point from the operator, the direction of the pressure is more towards the abdomen than towards the diaphragm, and the remnant of force brought to bear upon the ribs is minimized by the intervention of the elbows of the patient between the hands of the operator and the part to be pressed.

In Rule II. the position of the hard roll of clothing furnishes exact counter-pressure; it makes most prominent the part to be compressed. This part is under the hands—the whole weight if he wishes—of the operator, he being all the time in an easy position. His sensitive hands and fingers distribute, direct and regulate the force employed. This force is exerted on the ribs not directly, but through the medium of the skin over them, made tense by the fingers in the intercostal spaces. The direction of the motion produced in the ribs is natural, being first upon the spine at the costo-vertebral articulation, the spine being a fixed point; next upon themselves in the direction of their long axes.

The fixation of the operator's elbows as directed enables him to substitute almost entirely his weight for the force of muscular exertion.

The final push ending the pressure corresponds to the twitch with which, after the bow has been bent to its utmost, the boy starts the arrow from his bowstring—it causes a sharper rebound.

The substitution of seven to ten respiratory movements for the fifteen per minute hitherto universally adopted, may—especially to such as have never spent an hour at attempting resuscitation—need some justification. Apart from the fact that making the previously authorized movements 900 times an hour is a feat quite impracticable to an untrained person, this rate is on other accounts equally inexpedient. In a healthy person in the supine position a maximum of three or four respirations per minute incurs little inconvenience—certainly no discomfort—and is therefore manifestly more than is necessary simply for the maintenance of life. A rate twice as fast as this is, I think, for an unconscious person, fast enough. Besides, the movements are then made more effectively, incur less incidental disturbance of the patient, and less fatigue to the operator. The interval of three seconds, as here directed, I deem expedient, because there is often a secondary wave of rebound; this is valuable, and should not be cut short. The interval is thus good for the patient; it also rests the operator.

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* These three points have been demonstrated by me to eminent anatomists, surgeons and physiologists at King's College Hospital, Guy's Hospital and at the Royal College of Surgeons of England. And in view of the novelty, interest and importance of these facts, together with demonstration of the practicable impossibility of elevating the epiglottis by any amount of traction upon the tongue, and of some other points yet to be presented, a written statement that such demonstration had been witnessed, by them was given me by Gerald F. Yeo, M.D., Professor of Physiology; E. H. Howlett, M.R.C.S., House Surgeon, and others of King's College; and by Mr Thomas Bryant, Dr. C. Hilton Fagge, Dr. F. A. Mahomed and Mr. C. J. Symonds, of Guy's Hospital.

The adaptation of the artificial movements to returning gasps, impracticable in other methods, is directed here, waiting upon Nature being deemed better than ordering her, or of running the risk of crossing and interrupting her own feeble returning efforts. As during all of Rule II. the patient is close under the eye and touch of the operator, no symptom escapes his notice, and the aid required can with utmost delicacy be adapted to the occasion.

Cases which suggested the idea of this Method, other Methods being not Immediately Practicable.

When a house surgeon in New York, I was called to a man asphyxiated from opium-poisoning, and rapidly approaching articulo mortis. The method of Marshall Hall, which was the only one then known, I instantly attempted to perform. The patient, however, was a large man, was laying deep in a feather bed, and this was on a sacking bottom. At each pronation the mouth unavoidably was buried in the bed. Moreover, the difficulty of the process was such, I was soon too much exhausted to continue it. It occurred to me to get upon the bed, and, though too much exhausted then to make much manual pressure, to supplement it with my weight. Under this procedure the color of the lips soon improved, and once I thought I detected slight pulsation at the wrist. This was but temporary, however, and on the advice of Dr. Mott, who some time after arrived, I relinquished further effort. The yielding of the spinal column, bed, and sacking bottom, suggested to me the importance, should a similar case occur, of using some means of counter-pressure.

Some years afterward I was in consultation with Dr. A. Underhill, of New York, in the case of a lady, in which, during an examination, chloroform, carried simply to the point, as we thought, of anæsthesia, was used. Subsequently, after a rather prolonged consultation in another part of the room, we found, to our amazement, on returning, our patient apparently quite lifeless. This patient was larger and fatter than the other, and so much sunk in a large feather bed, that the Marshall Hall method was quite impossible. The bedstead had the old-fashioned high head-board and foot-board, and was a fixture in the corner of the room, and thus there was no space for the movements of the Silvester method. My experience of several years before occurring to me, I at once stuffed the bolster and some clothing beneath her back, and proceeded with what is now called the Direct Method. The effect upon the thorax was pleasingly apparent, and after a few minutes the patient gave a gasp. This I aided and deepened, and, continuing this a short time, the breathing became quite natural. A moment's delay in attempting to remove this patient we felt would be criminal. We had but one thought—respiration, and that instantly. Dr. Underhill always insisted, and I am inclined to agree with him, that but for the instant applicability and use of the Direct Method on the spot, just where the patient lay, her restoration must have been impossible.

Cases Illustrating the Application of the Rules of the Direct Method.

Case of Drowning in which the instructions of the Royal Humane Society and of the National Life-boat Institution would have been insufficient.—A passenger, by a lurch, fell overboard into the ocean, the steamer making about thirteen knots, and was accordingly in the water not less than twenty minutes. The chances of resuscitation seemed so small, I was impatient and commenced at once with Rule II. The thorax, however, did not seem to respond. I applied Rule I. At once a very large amount of water and of dinner, just before taken, was ejected. Rule II. being re-applied, the thorax now responded freely, and in about ten minutes the patient gave the first sign of returning life. After about ten minutes more of respiratory training, the respiration became natural. There was no relapse. But for Rule I., for the object of which the published instructions of the above Societies furnish no directions, Rule II. would, I believe, have proved useless, and the recovery effected would have been impossible.

Case of Chloroform-poisoning, in which the Ready Method was on the spot impracticable.—At my clinique in the operating theatre of the University of Vermont, I was operating on a young woman, assisted by Professors Ordronaux and F. A. King, Dr. Peck, Assistant of the Chair of Surgery, and others. The chloroform to the point of anæsthesia I had given myself. Intent afterward upon the operation only, my suspicion was first excited by the almost bloodlessness of the operation. Asphyxia was complete, and Professor Ordronaux could detect no movement of the heart. The case was very alarming, and several gentlemen, for different reasons, simultaneously left the theatre. The operating table was such a narrow one that the performance of the Marshall Hall method upon it was impossible. Instantly, therefore, I stuffed the pillow and some clothing firmly beneath her back, and proceeded according to Rule II., but standing beside the patient upon a chair, the narrowness of the table making kneeling astride the patient impossible. The patient in a few minutes gave a gasp, the respiration soon became quite natural, and the operation was completed.

APPLICATION OF THE DIRECT METHOD TO CASES OF STILL-BIRTH.

The child lies along the left hand of the operator, the ball of whose thumb takes the place of the hard roll of clothing. Over this the shoulders decline, the head falling back with arms, if convenient, on either side of the face. The buttocks and thighs are supported by the operator's fingers. Thus the operator has the prominent little thorax completely within the grasp of his right hand, with firm counter-pressure behind, enabling him to apply, locate, distribute, direct and alternate his pressure as he pleases.

Case which first suggested this application of the Direct Method, other methods being, under the circumstances, inapplicable.—I was called to apply the forceps in a primiparous labor, which had already lasted nearly three days. It was a seven months' child, and, as I had apprehended, it presented when delivered no present sign whatever of life, and from its color no future prospect of it. Cold air, spanking, hot and cold water, etc., naturally proved useless. Division of the cord, I was sure, would be final to any lingering possibility of hope. Tethered between the thighs of the mother, the methods of Marshall Hall and of Silvester were alike impracticable. Holding the child in my left hand, I proceeded, however, with the Direct Method, as described above, stopping now and then, and making, quite unaided, mouth-to-mouth insufflation. In about twenty minutes the child commenced to breathe, and she is now one of the most vigorous girls I know. During this entire procedure, with the exception of the head and shoulders, there was no exposure of either the mother or child.

Case showing the ease with which in still-birth certain adjunctive measures can be simultaneously employed with the Direct Method, which with other methods are impracticable.—This case, the next which came to me of its kind, was one of obstructed labor to which I had been called at the request of Dr. A. B. Ball and Dr. N. B. Emerson, of New York, to apply the forceps. For an hour and twenty minutes the head of the child had been submitted to all the force I could command, and naturally enough on delivery the child appeared, as was expected, hopelessly dead. I proceeded to apply the Direct Method under flannel, holding the child in my hand on my knee, Dr.

Emerson making alternate mouth-to-mouth insufflation. This was so well done, the little thorax each time expanded so much in my hand, that to my feeling the process resembled as nearly as possible the use of the ordinary rubber spray or syringing apparatus. The nurse meanwhile applied friction under the flannel. A warm bath being now ready, the child was transferred to that, and the entire process, minus only the friction, was unremittingly continued in it, the water being maintained at proper temperature, without disturbing the process. How it was I don't know, but for about an hour and a half the bright or livid color of the lips was entirely at our bidding; beyond this, however, no sign of life appeared. I cannot doubt, from the facts, that but for the great and prolonged cerebral compression, respiration in this case also would have been established.

To quote from various ordinary cases of success would serve no additional purpose. I have as briefly as possible given these, because they both illustrate what I want to show of the process, and at the same time explain the origin of the method and its applications. These last cases show that, in asphyxia neonatorum, this method can be applied at the instant of birth, and, if wished, before sacrificing the maternal connection. For mouth-to-mouth insufflation—which in still-birth I deem of first importance—the position of this method is, I think, the best and the most convenient which in any case could be devised. I think the examples here given show that, in any case whatsoever, not only can the Direct Method be instantly applied on the spot, but that adjunctive measures of every sort—whether bath, friction, electricity, insufflation, and, distinctively, even tracheotomy—can be used simultaneously without interruption ; all of which with any other method would be impracticable.

THE ORIGIN OF THE FORMULATION OF THIS METHOD IN THE DIFFICULTY OF MAKING THE PRINCIPLES AND FORMULÆ OF OTHER METHODS UNDERSTOOD BY LAYMEN.

Notwithstanding more or less of the experiences just narrated, in my lectures in the University of New York, as also at the Long Island College Hospital, I allowed myself to teach only the authorized methods of Marshall Hall and of Silvester. An event, however, occurred which unexpectedly compelled me to consider the entire question from a new stand-point. From a report I had prepared, it appeared that, of the (I think) 244 deaths from drowning during the previous year within the metropolitan district of New York, not one appeared to have been reached by a medical man in time for an attempt at resuscitation.

Under the auspices of the New York Board of Health, I endeavored to solve the problem whether it was not possible for the harbor police, who more generally rescue these unfortunates, to be made competent also to do something for their resuscitation. Ordered to head-quarters in squads for the purpose, I took for my guide the published Instructions of the Royal Humane Society and of the National Life-boat Institution of England, and endeavored to teach them to these men accordingly. To make these methods understood I certainly tried most earnestly and faithfully, but as certainly did I most signally fail. These men had but little notion of gravitation, less of respiratory muscles, and the relation between the motions taught them in either of these methods and the motions they could see in simple natural breathing they somehow always failed to comprehend. They learned, therefore, accurately, little or nothing of either method, and in the excitement of a subsequent emergency their notions and motions were more confused than ever. My only inclination was to abandon the whole matter. The responsibility, however, was a serious one, and I accordingly undertook to see how far the methods in question could be stripped of superfluous motions; how the essential feature of alternate thoracic compression and expansion, common to both and all methods, could be presented in the nakedest, simplest form. The result was that, instead of throwing the men a nut to break their teeth upon, I was afterwards able to give them simply the kernel; this kernel was the Direct Method. This name I gave it at once, because, in contradistinction to the indirect ways of the other methods, by these rules the two or three things to be done are simply done—done as they would be in any other matter of daily life. The tongue is to be brought forward; it is pulled forward. The chest is to be pressed—it is pressed;—and that without waste of time, strength, or motion. The result of the change was to all concerned very gratifying. The first day I ventured to teach the Direct Method, Rule I. was made to explain itself in a way I did not intend, the volunteer subject having but just had his dinner.

In explaining Rule II., having put a comrade patient in position, with black ink I described by continuous outline the lips, trachea, apex and conical contour of the bony walls of the air-chest, and with red ink marked the line of the diaphragm at its base. Beside this amateur patient I placed an old-fashioned pair of kitchen bellows, kept widely open by a spiral spring at its base. I need hardly say the nozzle, windpipe, hard conical sides, pliant leather base, presented sufficient similarity to the ink outlines I had made on the patient to be quite amusing. But in illustrating simultaneously the action of the operator, both upon the one and upon the other, side by side, the manifest compression, rebound, and audible gasp, presented an analogy so complete, all I had to say about the steady increase of pressure ending with a short push, about the rhythm, the persistence, the gentleness to be employed, as in reviving a dying ember, was entirely anticipated, and each man I found on the first lesson to be as competent as he was impatient to "blow the belluss," as he called it, of his comrade. The lectures were henceforth anticipated by the men as much for the entertainment as for the instruction. It so happened the next morning one of this first squad fished out an unfortunate man who had sought relief by drowning, near Catherine Ferry; and though for twenty minutes after rescue he gave no sign of life, this policeman succeeded in establishing respiration, and within two hours the man was able to return to his lodgings.

OBSERVATIONS UPON THE DIRECTIONS FOR THE TREATMENT OF THE DROWNED, PUBLISHED BY THE ROYAL HUMANE SOCIETY AND THE NATIONAL LIFE-BOAT INSTITUTION.

Although I have for several reasons a strong disinclination for the criticism of other methods, I can scarcely conclude this paper without, in the interest of the societies whose aim I have so much and so long shared, making one or two observations growing out of considerable experience with the Directions published by the Royal Humane Society and the National Life-boat Institution.

In the report of the Medical and Chirurgical Society's Committee of 1862, Experiment 19 is cited to show "the enormous force" with which foreign substances may be drawn into the air-passages, and Experiment 39 to show that in death from drowning, as contrasted with that from simple apnœa, "the lung substance appeared to be saturated and sodden with water." My own experience not only corroborates this as true in cases of prolonged submersion, but that in submersion for shorter periods sufficient water frequently gets into the stomach to embarrass seriously the action of the diaphragm. In neither of the published instructions referred to, however, are any directions given for the preliminary disposal in any case of this accumulation; notwithstanding, it is a frequent cause not only of serious respiratory obstruction, but which may be, as I have shown in a case of my own above related, sufficient to cause defeat of attempts at artificial respiration which might otherwise have proved successful.

Prominently in the first part of the instructions of both these societies is the following (the quotation is *verbatim* from the Directions of the National Life-boat Institution, those of the Royal Humane Society being substantially the same): "Draw forward the patient's tongue, and keep it projecting beyond the lips; an elastic band over the tongue and under the chin will answer the purpose, or a piece of string or tape may be tied around them; or by raising the lower jaw the teeth may be made to retain the tongue in that position." Although fully appreciating the object of this direction, yet, after careful personal inquiries of the *employés* of these and similar societies in different countries, I have obtained but one instance of drowning in which, during the past twenty years, the first part of this rule has been followed. That instance was when a surgeon of the Royal Humane Society happened to be himself bathing at the time of a drowning casualty, and with the forceps of the institution in Hyde Park he prized open the jaws, and, as directed, "pulled forward the patient's tongue." Regarding the remainder of the rule quoted, I have not found one instance in which either of the other directions in it have been followed. After many trials personally, I have found the procedures as directed are, for myself, quite impossible; that may help to explain the total neglect by the public and by the various societies' *employés* of the whole rule occupying such a prominent place in the published instructions. To perform the semi-rotation of an apparently dead body, or to take the necessary step forward and step backward, making besides in either method the alternate pressure directed, "about fifteen times a minute, or nine hundred times an hour," as directed, would be a feat exceedingly difficult for even a trained operator, and one which, as I think I have shown, even if accomplished, is one in every respect perhaps of doubtful expediency. The direction further on that "the above treatment should be persevered in for some hours," everybody will agree is one which, if intended to be followed by the same person, might admit of revision. Laying aside the possible effectiveness of the methods contained in the published instructions referred to, I have had Humane Society *employés* on the Seine, Rhine, Danube, Thames, and on various coasts, practice upon my own person the methods in question. I am sorry to say that never but once, however, and that was in London, have either of these methods by any of these men been performed upon me as if the operator understood the *principles* of the method in question. We must all agree that the practical value of a given method to the public consists not only in the possible effectiveness of that method, but also in the ease with which it is likely to be understood and practiced by the average layman.

Advantages of the Direct Method over other Methods in Directions issued for Public Use.

1st. It provides for ejection and drainage of fluids, etc., from the stomach and lungs, and in such a way that each motion for ejection induces an alternate inspiration.

2d. It excludes the tongue from the pharynx without manipulation.

3d. It secures elevation of the epiglottis, and a post-oral air-way from the glottis to the nares.

4th. It includes a remedy against syncope and cerebral anæmia.

5th. It obtains a more general expansion of the thorax.

6th. It effects a thoracic compression which is more complete, better distributed, directed and regulated.

7th. It is done by one person, and can be applied instantly on the spot wherever the patient is found.

8th. It is more easily understood by the illiterate.

9th. It is less fatiguing to the operator. In both rules there is but one motion; that is simple, the force employed being chiefly the weight of the operator, with intervals between each motion of complete rest. As far as weight of the operator will permit, it can accordingly be performed by any person of any age or sex.

10th. Instead of probable interruption of returning respiratory efforts, aid is accurately afforded them till the breathing becomes natural.

11th. There is no unnecessary motion or violence, with its occasional dangers, at the most critical moment.

On sending this to press, I am unexpectedly in receipt of a report of the United States Government Life-Saving Service for the year ending June 30th, 1877. After speaking of the substitution of the Direct Method for those above referred to, it goes on, in contradistinction to previous experience, to say: "*This method they* (the keepers and crews) *easily acquire and understand, and several opportunities for its application have occurred, each of which has been successful when the attempt could be made within a reasonable time.*"—*The Lancet.*

Items.

THYMOL.—The essential oils of thyme, of American horsemint, and of the *Ptychotis ajowan* contain a substance, a homologue of phenol or carbolic acid, having the composition represented by $C_{10}H_{14}O$, and known as Thymol. For more than two years this has been used by German surgeons, and is now being introduced among ourselves. It was discovered in 1719 by Caspar Neumann, examined chemically by Lallemand and Leonard Doveri, and first used to deodorize unhealthy wounds by Bouillon and Paquet, of Lille, in 1868. In 1875 several German surgeons published investigations of its antiseptic properties, which are estimated to be from 4 to 25 times as powerful under certain circumstances as those of carbolic acid. Thymol is a crystalline, nearly colorless body, with a pleasant odor and an aromatic burning taste. Its specific gravity is 1.028, and it melts at 44° C. It dissolves in 1,200 parts of cold water, 1 part of rectified spirit, 120 parts glycerine, and in ⅓ part of caustic alkalies. Fats and oils also dissolve it readily. It is prepared from the oils of either of the plants before mentioned, but pharmacists should beware of experimenting on English samples of oil of thyme, as but few of them are genuine, or, at least, contain any thymol. The oil is said to yield as much as 50 per cent of Thymol on the Continent. Thymol can be manufactured from these oils by treating them with an equal volume of a 20 per cent. solution of caustic soda, separating the alkaline liquid, and neutralizing with hydrochloric acid, when the thymol will float to the surface. It may also be obtained by submitting the oils to a low temperature for a few days, when the thymol crystallizes out. Its powerful antiseptic action, exceeding under some conditions that of carbolic acid, its small activity as a poison—about one-tenth of that of carbolic acid—and the absence of irritating effect when it is applied to the skin, all point to its use as a substitute for carbolic acid in the now well-known antiseptic treatment of surgical cases elaborated by Professor Lister. This substitution has been made with great success by Professor Volkmann, of Halle. For the spray solution, this gentleman uses a mixture of 1 part thymol, 10 alcohol, 20 glycerine, 1,000 water; but we understand that a solution in water only, which will not deposit, may be made by adding 1 part of thymol to 1,000 of hot water. For the gauze dressings used by Professor Lister, others were substituted, made by saturating 1,000 parts of bleached gauze with a mixture of 500 parts spermaceti, 50 resin, and 16 of thymol. This prepared gauze is extremely soft and pliant, and, to use the words of the reporter, sucks up blood and the secretions of the wound like a sponge. The fibres of the gauze being impregnated with spermaceti, cannot, of course, become saturated with the secretions, so that they do not become stiff. Thymol has been used for various skin diseases by Dr. R. Crocker, but the results of his experiments have not yet been published. As an internal remedy, thymol does not seem to make much way. It has proved useful in diseases of the stomach accompanied by fermentation, and Mr. W. H. Stone reports in the *Medical Times and Gazette* that he has found it useful in cases of chorea, one form of which is St. Vitus' Dance. The present cost of thymol is about five times that of the best carbolic acid, but as one part of the former seems to do as much work as 25 parts of the latter, the advantage of price is on the side of thymol.—*Chemist and Druggist.*

THE COMPOSITION OF PUS.—The twenty-fifth part of Fehling's *Neue Handwörterbuch der Chemie* contains a short but carefully worked-up article on Pus, in which, after some preliminary account of its general characters, the following particulars are given. The constant chemical constituents of pus are water, alkali, albuminate, and three other albuminous bodies, one of which coagulates at 48° to 49° C., and is insoluble in a 0·1 per cent. solution of common salt and in a dilute solution of soda; a second insoluble in water, but swelling up in a solution of salt, and soluble in a 0·1 per cent. solution of hydrochloric acid; and a third insoluble in solution of salt, but soluble in a 0·1 per cent. solution of hydrochloric acid. In addition it contains nuclein, fats, soaps, cholesterin, lecithin, cerebrin, phosphureted fats, and inorganic salts, of which the chief are sodium chloride, phosphates and carbonates of the alkalies, phosphate of lime, and some iron oxide. The nuclein albuminous constituents, cerebrin, cholesterin, and lecithin, belong to the pus-corpuscles. The occasional, or, as they may be regarded, abnormal constituents of pus are mucin (from mucous membrane), chondrin, gluten, chlorrhodinic acid, pyocyanin and pyoxanthosis (in blue pus), biliary acids and pigments (in the pus produced in icteric patients), grape sugar (in diabetics) and urea. When long exposed to the air, pus passes into acid fermentation, and then contains leucin, formic, butyric, and valerianic acids. Hoppe Seyler found in 100 parts of the serum of pus: water, 90·96 per cent.; solids, 9·04, of which albuminoids formed 7·02; lecithin, 0·10; fats, 0·04; cholesterin, 0·07; alcohol extract, 0·06; water extract, 0·92; inorganic salts, 0·77. One hundred parts of dry pus-cells contained albuminoids, 13·726; nuclein, 34·257; insoluble substances, 20·566; fats, 14·383; cholesterin, 7·400; cerebrin, 5·199; extractive, 4.433; and nearly 2 per cent. of salts.—*The Lancet.*

LARYNGOSTROBOSCOPY.—The actual vibrations of the vocal chords during the production of sounds have hitherto eluded direct observation. According, however, to a publication by Dr. Oertel, of Munich, their observation is a matter of little difficulty, and is likely to afford instructive information regarding the physiology of the voice. It is only necessary, he asserts, to employ a light sufficiently strong, and to provide an arrangement by which it shall be rapidly interrupted, to render the vibrations visible. The effect of the interruption of the light is to retard the perception of the individual vibration, or rather to prevent their impression on the retina from being modified before it can be perceived. Thus it is possible not merely to observe accurately the vibrations of one of the vibrating chords, but also to compare the vibrations of one with those of the other. The light which is employed must be of the most powerful character, by preference direct sunlight, or the electric or oxyhydrogen light. The interruption may be conveniently produced by a perforated diaphragm revolving rapidly, and at a rate proportioned to the rapidity of the vibrations of the sounding chord. Or it may be interrupted by a tuning-fork, and in the latter case a note should be chosen of the same height as that produced by the larynx under observation, or an octave from it. The interrupting apparatus must be placed between the light and the laryngoscope mirror, or behind this mirror between it and the observer; the latter is a convenient position for the revolving diaphragm when a little practice in its use has been obtained, and the diaphragm can be turned by the hand at the needful rate for observing the vibrations at a given note.

When a chest-note is uttered the laryngoscope shows the vocal chords vibrating in their entire extent, and the sharp edge cannot be seen. By the interrupted light these vibrations may be separated into the movements of which they are made up, but are seen to be still vibrations of the vocal chords as a whole. When, however, a falsetto-note is uttered the vocal chords are seen to be apparently scarcely moved, and with the interrupted light this is seen to be due to the circumstance that the chords are vibrating in sections, two or three, according to the height of the note, the sections being divided by one or two nodal points.—*The Lancet.*

MEDICAL LEGISLATION.—A bill has been prepared, entitled "An Act to better regulate the Practice of Physic and Surgery in the State of New York," and it is now being considered by the Senate Committee on Public Health. The prospect of its passage by both Houses is thought to be very favorable. The bill provides that every person lawfully engaged or about to engage in the practice of physic and surgery shall register under oath, in the office of the Clerk of the County in which he resides, his name, residence, birthplace, date of his diploma, license, or certificate, and the name of the College, Society, or body by which he was qualified as a physician. The censors of each Incorporated County Medical Society shall inspect the registry twice a year, and certify such inspections; and it shall be a misdemeanor for any person, except those now lawfully engaged, to *practice* medicine unless he shall have obtained a degree from an Incorporated Medical College, or from the Regents of the University of this State. Any person found guilty of this misdemeanor shall be fined not less than $200 nor more than $300, and be imprisoned until the fine is paid, and in addition to the fine, he may be imprisoned for a term not exceeding six months; for a subsequent offence the offender shall be fined not less than $400 nor more than $600, and be imprisoned until the fine is paid, and he may be imprisoned also, as part of the punishment, for a term not to exceed eighteen months. One-half of all such fines shall be paid for the use of the Medical Society whose President shall institute proceedings against the offender. The bill also declares the neglect of a physician in practice to register his name, etc., with the Clerk of the County, a misdemeanor, and its last section is meant to accomplish the repeal of the Act of May 11th, 1877.—*New York Times.*

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GOLD BLOCKS.

We have just succeeded in making a block, very cohesive,

SOFT UNDER THE INSTRUMENT,

And almost entirely free from the tendency to tip and curl up, which is so annoying.

They will be made in the same sizes as the Rectangular Gold Pellets and Corrugated Gold Blocks.

Small quantities can be supplied at once.

R. S. WILLIAMS.

Fillings Colored

TO CORRESPOND WITH THE SHADE OF THE TEETH.

GOLD AND PLATINA,

PATENTED COMBINATION.

We are much indebted to GEO. T. MOFFATT, M.D., for assistance in regard to this preparation.

In the manufacture of this filling, a layer of platina is covered with a layer of pure gold on each side, and the whole firmly united. As the gold is on the outside, all the cohesive properties are obtained. When the filling is finished, the color will be found to be between the colors of gold and platina, and will incline towards the one or the other, according to the proportions used. Platina is as pure a metal as gold, and stands in the mouth equally well—hence there is no danger of *discoloration.*

Do not anneal beyond a dull red—a lower heat will usually suffice.

While we expect to make the above in different shades, it will be impossible to make them all at first; and it has been decided to begin with shade 3, which will meet the greatest number of cases, and to make it into

Rolled No. 30,
Cylinders Nos. 1 and assorted,
Blocks Nos. 2, 4 and assorted.

Price of shade 3, $3.75 per ⅛ oz.

R. S. WILLIAMS.

FILLINGS COLORED

To Correspond with the Shade of the Teeth.

GOLD AND PLATINA COMBINATION.

(Patented.)

Jan. 5th, 1878.

Mr. R. S. Williams,

Dear Sir:—In answer to your question about the working of gold and platinum in alternate sheets, as prepared by you, I have to say that for teeth in the front of the mouth or in other conspicuous positions I no longer use gold for building out those portions that show.

These two metals can be so used as to get a far better approximation to the color of the tooth, especially if it be somewhat discolored, and by finishing with Scotch stone, a surface is left that scarcely attracts attention. It is very hard when packed, and after nearly three years' wear I can detect no change in the surface or edges.

I consider it a very valuable acquisition to artistic dentistry.

Respectfully yours,
E. A. BOGUE.

Mr. R. S. Williams,

Dear Sir:—In reply to your question as to the working of the combined platina and gold, which you have recently brought out, I would say that the results in my hands have proved very satisfactory. The blocks are as easily worked and manipulated as *all gold* blocks, and the cohesive properties are apparently just as good; while for conspicuous fillings it is a vast improvement over the yellow nuggets that we have heretofore been accustomed to.

With some improvement in the shades, and the new system of numbering that you propose, I think the material will be perfect.

Yours very truly,
GEO. T. MOFFATT.

Jan. 28th, 1878.

Mr. R. S. Williams,

Dear Sir:—In reply to your inquiry regarding the gold and platinum cylinders, I can only say that I am greatly pleased with them.

The color of a filling made with them is so much nearer that of the natural teeth, that I have found great satisfaction in their use in conspicuous cavities—particularly those near the gums on the anterior surfaces of the front teeth.

I have not yet met a patient who has not greatly preferred their color to that of gold.

Yours truly,
S. G. PERRY.

Hartford, Conn., Jan. 21st, 1878.

Mr. R. S. Williams,

Dear Sir:—I am more than pleased with your "Gold and Platina Blocks." They are just what I have wanted for a long time, and work beautifully.

GEO. L. PARMELE, M.D.

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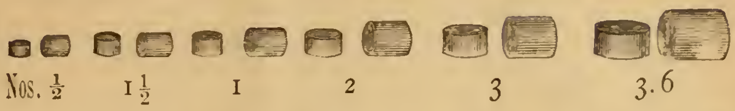
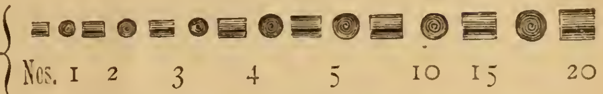
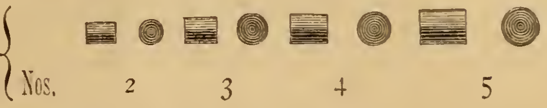
Loose, and can be used as Pellets.



STYLE B,
Compact, but not Hard, used as Cylinders only.



STYLE C,
Loose, but more compact than Style A.



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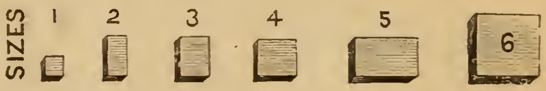
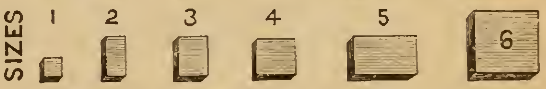


THICKNESS B.
No. 3 FOIL IS USED FOR THIS.



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Sizes same as Rectangular Gold Pellets.

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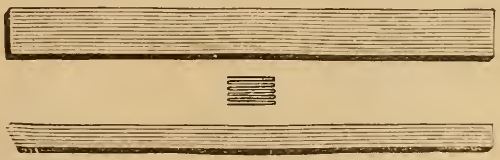

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